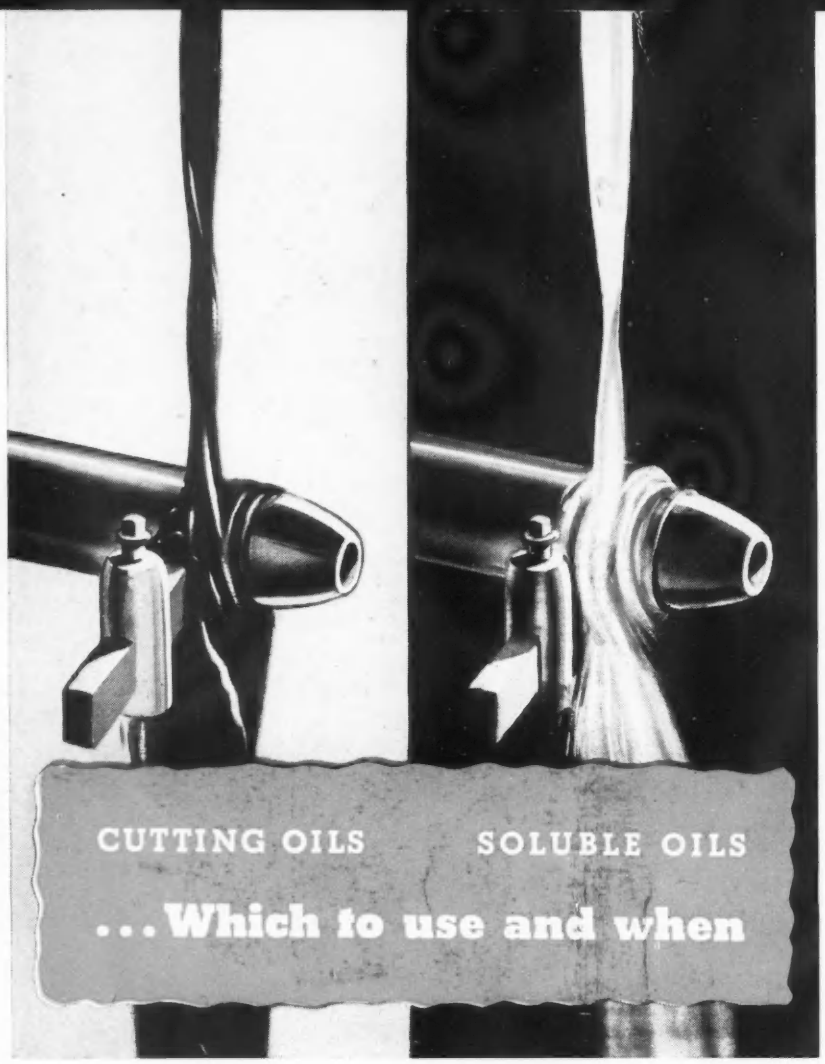
AUTOMOTIVE and Aviation INDUSTRIES

JUNE 1, 1943

Official U. S. Navy Photograph from Harold M. Lambert.



● Cutting fluids—emulsifying and non-emulsifying—have definite uses in machining. Neither type will do *all* the jobs efficiently in most plants. The choice between them depends upon many factors: the type of operation, speeds, feeds, and metals worked; tool life, and the finish required.

The extra time and trouble it may take to find exactly the right cutting fluid for any operation will pay dividends in faster production, labor saving, and tool economy.

Cutting fluids have two main functions:

1 To carry away heat from the tool and work.

2 To reduce adhesion between tool and chip.

Machining operations may be roughly divided into four classes, and the cutting fluid requirements for each generally laid down as follows:

Type of Operation	Important function in **black type**
Low speed, shallow cut	cooling; **reducing adhesion**
Low speed, heavy cut	cooling; **reducing adhesion**
High speed, shallow cut	**cooling**; reducing adhesion
High speed, heavy cut	**cooling**; **reducing adhesion***

**Note—except where carbide-tipped tools are used.*

Oil is ammunition . . . Use it wisely

Cutting Oils are used:

—in low viscosities, as coolants, and also to reduce adhesion.

—in higher viscosities to reduce adhesion and lengthen tool life on heavy cuts.

—on any machines in which a water emulsion would impair the lubrication of ways, guides, spindles, etc.

Soluble Oils are usually used:

—where cooling is paramount and there is little need for reducing adhesion.

—where a cutting fluid would not normally be needed, such as on low speed shallow cuts, except to prevent rusting.

—in most grinding operations because of the great need for cooling. In addition, a water emulsion allows minute grindings to settle out quickly and reduce scratching of the work.

—on operations such as drilling where fine finish is not essential.

—where carbide-tipped tools are used which require maximum cooling.

—on some deep drilling or boring operations where the fluidity of the emulsion assures ample flow of coolant to the tool.

These suggestions are merely guides in the choice of cutting fluids. Almost every machining operation poses a special problem. To make certain that you get the most economical answer get a Standard Cutting Oil Engineer's recommendations.

Call the nearest Standard Oil Company (Indiana) office, or write 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. In Nebraska, call any Standard Oil Company of Nebraska office.

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CUTTING OILS
AND COOLANTS

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

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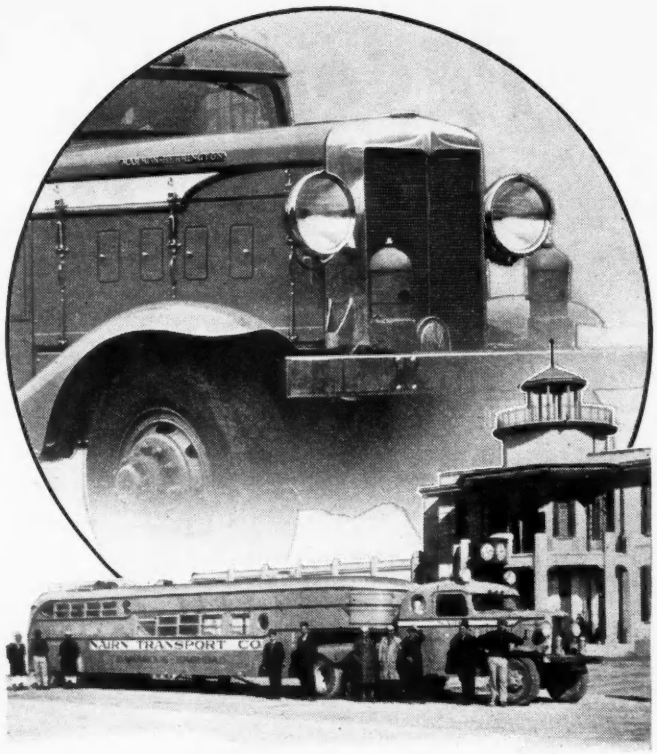

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So effective have Texaco Lubricants proved that they are definitely preferred in many important fields, a few of which are listed in the panel.

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IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 88 June 1, 1943 Number 11

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

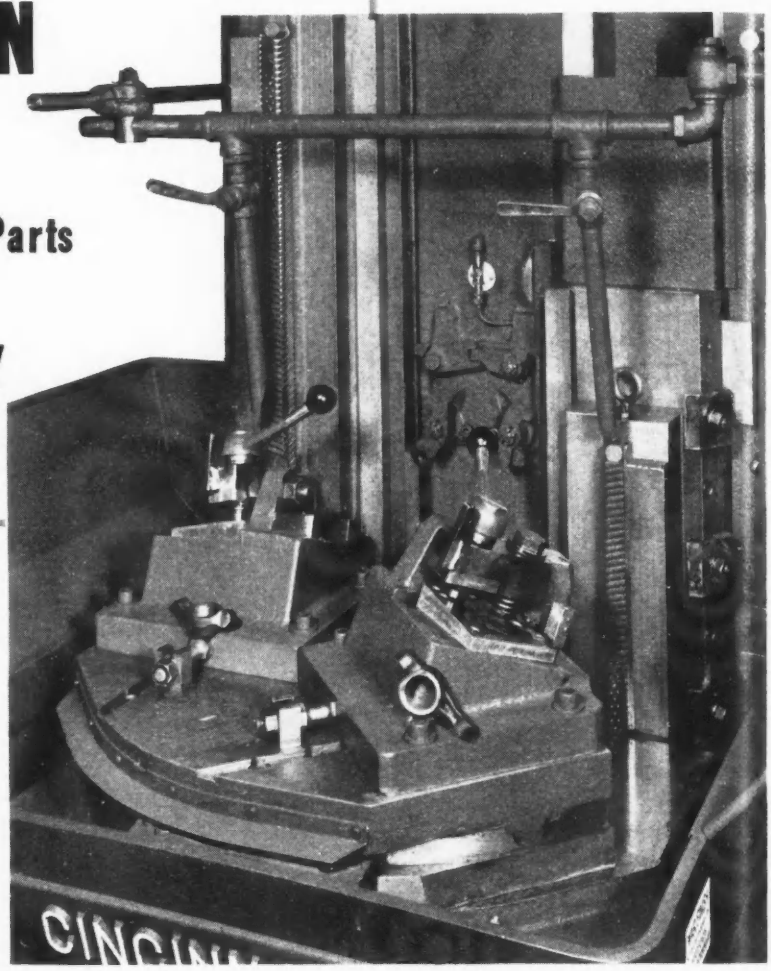
Bigger Efforts

Lockheed Aircraft Corp. is tooling up for volume production of the Constellation (C-69) four-engine transport plane. The plane is powered by four 2000-hp Wright engines and has a 4000-mile range at 283 mph. It is expected that some planes will be delivered this year, with deliveries being stepped up in 1944. Lockheed also is increasing its production rate on P-38 Lightnings.

Production of aircraft engines by the Pratt & Whitney Division of United Aircraft Corp. has expanded so greatly at East Hartford, Conn., that five satellite plants have been set up in nearby communities to increase parts production. These plants are located at Buckland, Hartford, Willimantic and Southington, Conn., and East Long Meadow, Mass. The Southington plant, for example, will turn out only cylinder heads and barrels for final assembly in East Hartford. Six other U. S. manufacturers are producing Pratt & Whitney engines under license—Ford, Buick, Chevrolet, Nash - Kelvinator, Jacobs Aircraft Engine Co. and Continental Motors Corp.

PRODUCTION DOUBLED

While Retooling Aircraft Parts for QUICKER VICTORY



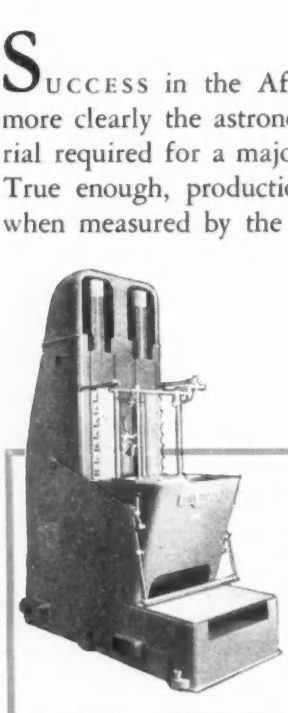
CINCINNATI

Success in the African invasion brings home more clearly the astronomical volume of war material required for a major invasion of the Continent. True enough, production has been very gratifying when measured by the standards of only a year or two ago, but now production figures must climb again. No time for self-satisfying back-patting; yesterday's problems must be studied anew.

An example of what can be done to increase the production of a part used in aircraft engines is illustrated here. Disregarding established methods, the CINCINNATI Engineering Service Department tooled up the job on a CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach Machine.

Production now averages slightly better than twice the former output

Perhaps a closer study of your own production methods will uncover opportunities to increase output . simplify operation for "green" help . . . develop higher quality. Our engineers are glad to give you the benefit of their experience to accomplish these results.



CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach. Write to us for complete engineering specifications; catalog No. M-894-1. Brief description may be found in Sweet's Catalog File for Mechanical Industries.

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 88, No. 11
June 1, 1943

Two Pack *Types Used to Export Army* Truck Shipments

TRUCKS are the backbone of the land supply system for military operations such as those of the United States and British armies in North Africa. They also play an important part on a dozen other battle fronts in transporting vitally needed food, materiel, ammunition and fuel from supply bases to the combat zones. Therefore, the problem of shipping thousands of trucks to overseas theaters of war is an important one, especially in view of the fact they must share shipping space with guns, airplanes, shells and other combat weapons.

Conservation of shipping space, "cubic" in export language, is a prime necessity due to the shipping shortage which has been intensified by the submarine warfare of the enemy. Accuracy of packing is another major consideration because a single missing part at the point where the truck is assembled may mean a vehicle immobilized as completely as if the engine or tires were missing. And often a replacement part might have to be shipped across thousands of miles of ocean.

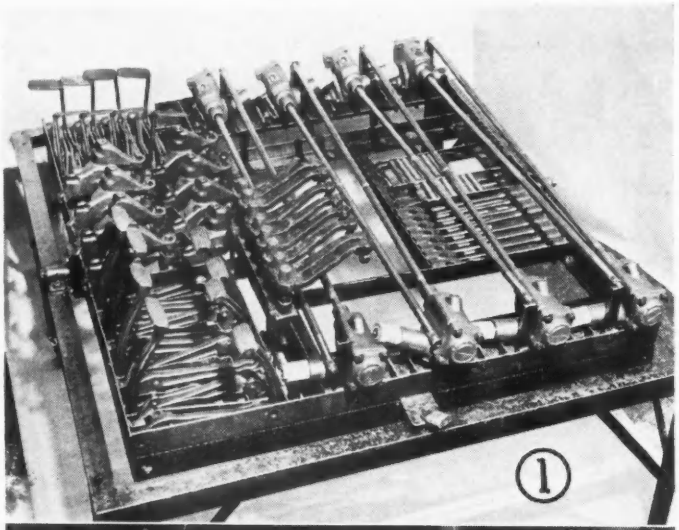
The Chevrolet - Bloomfield plant of General Motors Corp. at Bloomfield, N. J., is particularly fitted to box Army trucks for export because it has had 18 years' experience in the automotive export trade. Prior to the war, Chevrolet car parts were boxed at Bloomfield and shipped to General Motors Export Corp. assembly plants in all parts of the world for distribution to foreign buyers. More than 1,225,000 cars were thus shipped over a period of 16 years. Compact stowage was also important in peacetime because ocean freight rates are based on the cubic content of the shipments. And accuracy likewise was important due to the necessity of having sufficient parts to assemble all the units shipped.

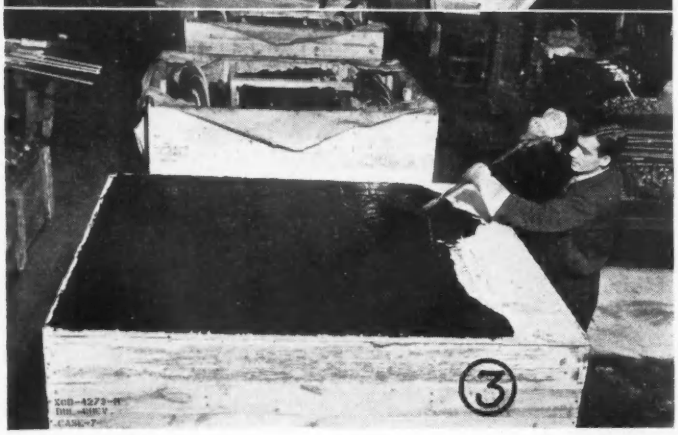
When the war broke out in Europe in 1939, Chevrolet-Bloomfield began shipping military trucks to some of the nations on the Allied side. This volume of business increased early in 1941 when Lend-Lease went into effect and thousands of trucks were shipped to Russia, Great Britain and other of the United Nations. With the entry of United States into the war, Chevrolet-Bloomfield was converted 100 per cent to military operations and the plant now has been boxing and shipping hundreds of U. S. Army trucks weekly for more than a year.

Two types of shipments are made from Chevrolet-Bloomfield. In the Two-Unit Pack or TUP, two partially assembled trucks are packed in three cases, exclusive of the bodies. The Two-Unit Pack is designed for ready assembly in the field with only a limited amount of tools and equipment. The Completely Knocked Down pack, known as CKD in automotive export circles, contains a unit of 24 trucks which is shipped to an automotive assembly plant in some part of the world close

By E. L. Warner, Jr.

Loading overseas truck shipments at Chevrolet-Bloomfield plant.





1—Jig for identifying and counting drive parts mounted on a trunnion, one side for right hand drive, other for left hand drive. When set up for right hand, it is locked in position preventing left drive parts from being inserted by error.

2—Close-up of cab box of Twin Unit Pack. Each Chevrolet cab contains 6 tires and wheels.

to the combat zone. There the trucks are put together with regular assembly line equipment and then driven to the theater of operations.

The CKD form of shipment now used is a direct adaptation of peacetime automotive practice now applied to military vehicles. The building devoted to this type of boxing is rectangular in shape, with spur tracks running down both sides. The incoming material is unloaded from the freight cars and taken down the material trucking aisles to storage spaces on either side of the various packing lines, which run crosswise of the building. There are 15 of these packing lines for various Chevrolet 4 x 2 truck parts, such as an engine line, an axle line, a sheet metal line and other lines where a multitude of small parts are packed into the cases with the maximum utilization of all space available.

Accuracy in packing the material is especially vital during wartime. A percentage inspection of each type of part is made against the engineering specifications. Then just before each case is packed, all materials to go into it are laid out on tables or in special fixtures by production men. It is then checked over by checkers as to condition, count and identity. A sample board of all parts packed on each line is maintained in a prominent place for a visual check of all material. Checking trays are divided into 12

3—Spreading cold patch on top of case of front axles. Cold patch acts as sealer and provides adhesive surface for water-repellent paper cover applied to box later.

4—Modern packing methods made possible the shipment of huge quantities of American automotive equipment to North Africa. The boxes in this photo were unpacked by native French soldiers and the truck parts taken to an outdoor assembly line nearby. (Acme photo).

Preparing chassis box in Twin Unit Pack at Chevrolet-Bloomfield plant. This is the largest of 3 boxes in Twin Unit Pack and weighs 6640 pounds. One chassis with engine is packed upside-down on top of the other.

squares where a number of small components must be counted. By placing the components in each square, the worker can tell at a glance whether he has the right number and type of parts on the tray. Twelve-square trays are used because that is a multiple of the 24-unit pack. A hand count is used on parts lot shipments up to 200 units, but checking by weight is done over that number.

Where there are right and left-hand types of the same part, special fixtures are used to assure the right number of each type. These fixtures make it impossible to put a right-hand part in a left-hand slot. Fixtures also are used to differentiate between parts for vehicles having right and left-hand drives. All vehicles shipped to parts of the British Empire, such as Bombay, Australia, Wellington, N. Z., Port Elizabeth, S. A., and also to Dublin and Buenos Aires are equipped with right-hand drives. Red fixtures are used to designate parts for the right-hand drive vehicles contrasted with white fixtures for the left-hand drive model parts. In the fixture for the pitman arm, for instance, serrations on the fixture will fit exactly this part for a left-hand drive but will not fit for a right-hand drive pitman arm. These differences are not perceptible to visual inspection. When right-hand material is needed, the fixture is turned over on a trunnion and the right-hand fixture comes into place, accommodating only parts for right-hand drive. More than 500 fixtures are used to differentiate between types of the same part. This type of inspection and checking makes it difficult for an employee to make a mistake.

On the engine packing line a check stop catches the clutch work and stops the line if an engine with right-hand drive attachments gets on the line by mistake when left-hand drive equipped engines are being

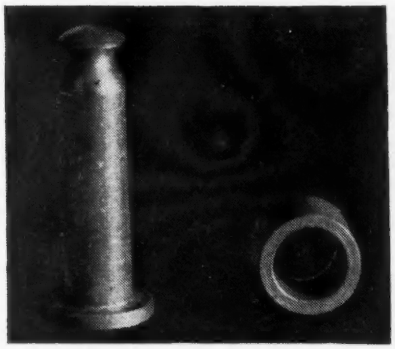
(*Turn to page* 64, *please*)

Hi-Shear Rivet **Replaces Bolts** *in Mustang Wing*

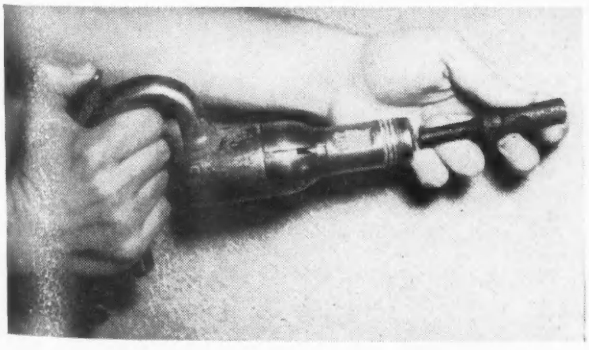
A NEW type of rivet with strength properties that make possible the replacing of bolts in aircraft and other structures at a substantial weight saving is being used at the North American plant to fabricate some parts of the wing of the P-51 Mustang fighter. A large number of the standard rivets and 798 bolts have been replaced by nearly 1000 of these new rivets, the net result being a 60 per cent reduction in weight in relation to the rivets and bolts formerly necessary.

The shear strength of this new rivet, which has been named the Hi-shear rivet, is 75,000 psi and it can be installed five times faster than a bolt. Since the Hi-shear rivet is too hard to be driven in the usual manner, it is set in place by a special tool (see illustration) that presses a small aluminum collar into the recessed end of the stud to form a modified conical head. Excess collar length is sheared off automatically during the operation by the sharp edge of the stud tip.

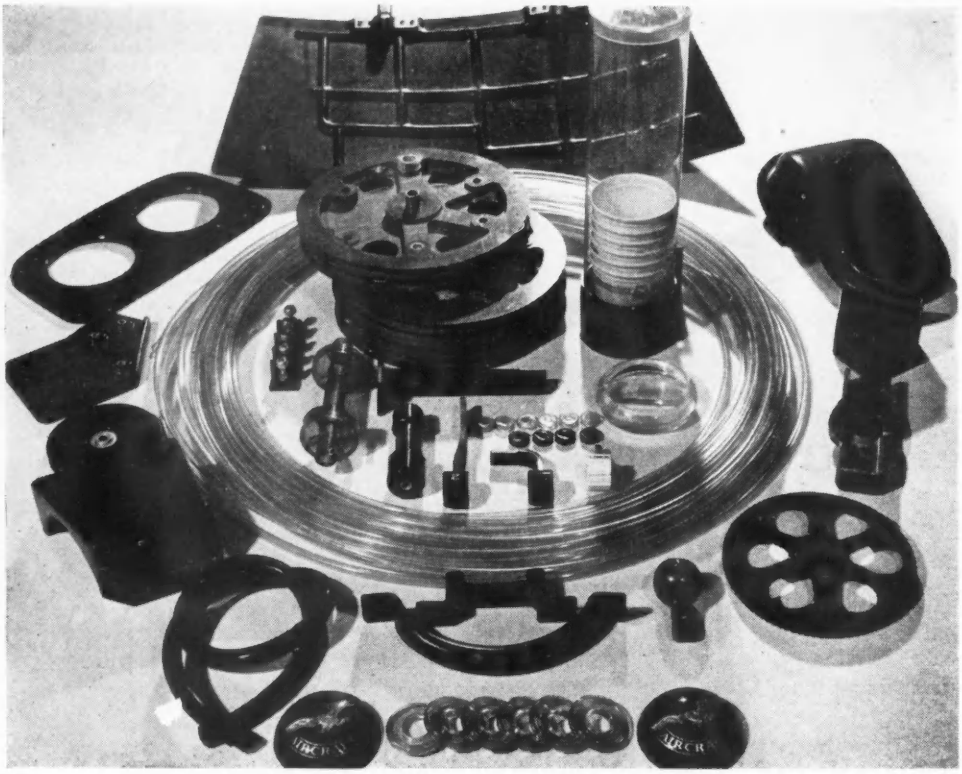
Both the rivet and special tool were developed by George Wing, a North American engineer. Hi-shear rivets are made with two kinds of heads and in several lengths and diameters, and have been made available to other war manufacturers.



Hi-shear rivet consisting of special stud and aluminum collar.



Pneumatic hammer and tool used to set Hi-shear rivet at North American plant.



Some of the total 1445 molded plastic parts which are used in the B-24 Liberator. Among the articles seen here are aileron quadrants, saving three pounds in weight; a cup container which costs $1.05 in plastics against $4 in metal, grommets for electrical application, vinyl tubing for battery drains and insulation, trim tab control wheel, control knobs, an antenna mast, thermos jug drain tray, and a small instrument panel.

Two and a half years of research in plasticized wood has taught us that it can be used to replace valuable aluminum alloys on the Consolidated B-24 Liberator, the new C-87 cargo landplane, and on other products now being built and projected. We have also learned that there are limits to the use of this material in such craft. For instance, a Liberator made of plasticized wood is out of the question due to the stresses imposed on the structure at the high cruising speed at which the plane operates and due to the load factors which are developed in combat maneuvers.

At present, with plasticized wood parts on the Liberator numbering 22, we are saving 205 pounds of aluminum alloys, and this is just the beginning. The replacement installations which have been tested and proved include all trimming tabs, guards for push-pull control rods and control cables, side gunner and life raft cradle doors, and the escape hatch in the pilot's compartment. Wing tips, 35 inches wide and 53 inches long, have not yet been installed, but we are experimenting with them.

Projected are nose wheel doors, pilot and crew seats and wheel-well domes. In connection with the latter it is interesting to note that not only are we experimenting with plasticized wood, but we are testing laminated cloth using a resin filler. As fast as research and tests prove that wood can replace metal at any other point, the installations will be made. The engineering work on this project is being done by Kenneth W. Woodson, plastic engineer and consultant, who has been with the company for more than five years.

There are several reasons why the company has concentrated on the development of plasticized wood. The first and most important, of course, is the saving of valuable alloys. In mass production, a saving of

Cable guards of plasticized wood have proved satisfactory.

Airplane Parts of
Plasticized Materials

By Frank W. Fink
Chief Division Engineer
Consolidated Vultee Aircraft Corp.
San Diego Division

a few hundred pounds per ship soon runs into tonnage. Second, we have found that in most cases where plasticized wood is used there is a considerable saving in weight. This saving may run as high as 40 per cent, even in such primary structures as trimming tabs. The average saving is 15 per cent. However, in highly stressed primary structure—the wing tips are an example—the difference between metal and wood, as far as weight is concerned, is negligible. Elevator tabs offer an extreme example of weight saving. The metal tab weighs .98 pound while the plasticized wood tab weighs only .59 pound.

While no weight is saved in the wing tip, the plasticized wood has advantages which become apparent in manufacture and in operation. In fabrication, the metal wing tip demands the use of blind rivets. The wood wing tip does not. In the event of wing tip damage in the field, proper repair calls for the use of a shop and skilled metal workers. Damage to the wood wing tips can be repaired by any carpenter.

Another example of weight saving is found in the side gunners' doors. Made of metal. these doors weigh 13.05 pounds, while the plastic wood installations weigh only 11.22 pounds. Similar lightening of the plane can be reported all down the line, which means that this poundage can be utilized for greater gas and bomb loads.

Cost is another factor to be considered. While some wood parts cost as much to fabricate as do like metal parts, the overall saving on installations in the Liberator averages about 15 per cent. The cost should be lowered somewhat further as production increases. Another advantage which cannot be overlooked is that the wood parts lend themselves to subcontracting. This means that with the work done away from our own factories valuable floor space is saved.

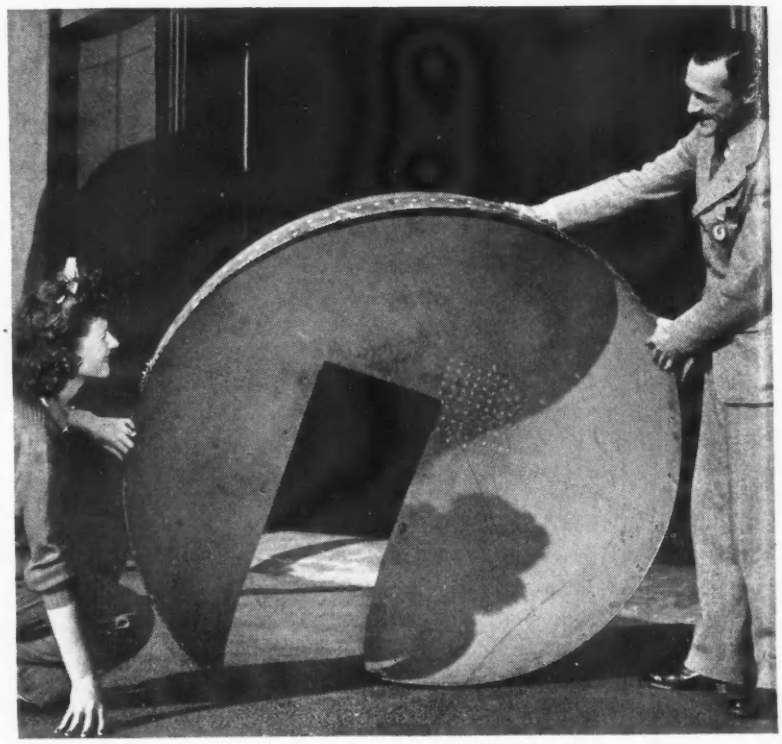
In addition to conducting research and tests on the Consolidated B-24 Liberator, we are following the same replacement policy on the new C-87 cargo plane. We also have found there are 30 parts on the PB2Y3, the four-engined flying boat, and we will begin replacements as soon as possible. In developing future models, at the outset we design many parts of plastic wood rather than alumninum alloys.

Our whole manufacturing effort at this time is in the preparation and testing of original plasticized wood parts. We do not attempt quantity production. As soon as a part has been proved, it is turned over to a subcontractor for mass production. This leaves our own oven free for development work.

We are baking in our oven under a steam pressure of 75 psi and a temperature of 320 F. We bake parts from fifteen minutes to half an hour, the baking time being proportional to the thickness of the part. As an example, plywood baked to one-half inch thickness would require a baking period of one and one half hours. We have found that use of pressure and heat as we do produces an exceptionally fine product, as the resin is forced through the wood, into capillaries and fibers. Tests on the product show that it has more dimensional stability, is more waterproof and has far better compression and sheer resistance than plywood which has simply been sealed under heat through the use of resinous glue.

One of the present problems is the wood form which we have been using. Not only are these forms costly

A relay and shunt box made of laminated fibreglass and cloth bonded by urea resin. At the right is Kenneth W. Woodson, Consolidated's engineering consultant in plastics.



A wheel well fairing of laminated plywood that weighs 13 pounds as compared to 30 pounds for the metal part. Fairings weighing 14½ pounds also are being made from laminated fibreglass.

to make, but they do not stand up under use. We are now experimenting with poured-plastic forms. These are fabricated by mixing resin with wood flour or walnut shell flour, followed by baking at 170 F. and curing. It is our belief that such forms not only can be fabricated more quickly and cheaply, but that they will not depreciate as rapidly as the wood block forms which we are now using.

We have had extremely good luck in riveting the plasticized wood. One method, used in the trimming tabs, is to bake cloth over the wood. This permits riveting without cracking. Another is the use of a washer under the head of the rivet. The washer is about three times the diameter of the rivet.

As originally stated, we do not see any future for the use of plasticized wood in heavily stressed primary structures on the Liberator. In this connection, it is interesting to note that were the Liberator constructed entirely of plasticized wood, its weight would be equal to or greater than the metal plane as it now is constructed. This would be due to the necessity for obtaining suitable strength to meet stresses encountered.

As fabrication improves, however, there is a definite possibility of building plasticized wood cargo planes. These would not have to stand the load factors imposed on such craft a. the Liberator. Plast wood is already being used, of course, with marked success in the construction of gliders, training planes and other equipment which is not subjected to extreme loads.

Consolidated not only is experimenting with plasticized wood, but at present has developed more than 300 molded plastic parts of different design for the Liberator. The work in molded plastics is also being supervised by Woodson, and is conducted as a unit in conjunction with plasticized wood research. Efforts are being directed to the saving of metals and to cheapness and lightness. There are so many types of molded plastics that a complete discussion of them in a brief space is impossible.

One example of money-saving, however, lies in a cup dispenser. We found that a plastic cup dispenser was 80 per cent cheaper to construct than the metal dispenser. As to weight saving, we learned that an aileron quadrant which would have to take a 1100-pound static load could be made of macerated canvas. It was 3½ pounds lighter than the metal part then used. Tests were run on the completed molded plastic part, and we were surprised to find that it carried 160 per cent of normal load without a sign of failure.

As another example, we found that a thermos jug drain tray needed but few small changes to be adapted to plastic material. Not only was metal saved, but a welding operation was eliminated. The thickness of the material was increased from .030 in. to .062 in., but no weight was added, due to the fact that the plastic used weighed only one-half as much as the metal.

Another part which has been produced in plastics is the throttle quadrant. The material thickness was increased from .091 in. to ⅛th in. as the change was made from metal. Other design alterations were negligible.

It may be generally said that in the use of molded plastics, which are used primarily for non-structural parts such as control knobs, fairleads, and brackets, that the weight saving is not great. This is due to the fact that generally molded plastics are double the thickness of the metal they replace, as pointed out

(*Turn to page* 56, *please*)

This new wing tip, measuring 39 by 58 in., is made of phenolic laminated paper, costs less to fabricate than the regular Liberator part and is lighter in weight.

Airbriefs

By Henry Lowe Brownback

Revolving Wings

As time goes on it becomes increasingly evident that one must take more and more into account the possibilities of the first type of heavier than air machine to ever fly—the helicopter. In 1784 two Frenchmen, Launoy and Bienvu, exhibited before the Academy of Sciences a little toy helicopter which actually flew, and in 1842, W. H. Phillips flew a two-pound helicopter driven by a reaction turbine. The first man-carrying machine of the type of which I have any record was flown in 1908 by Breguet over a distance of 64 feet and at an altitude of 15 feet.

The succes of the fixed-wing airplane seemed to have discouraged American investigators and the revolving wing was dropped here, but considerable work continued on it in Europe, all more or less unsuccessful until Cierva invented the autogiro. Now the first autogiro was a revolving wing aircraft, but it failed utterly to accomplish the thing of most importance in an airplane of this kind—absolute vertical ascent from a platform not much larger than the aircraft and controlled descent to the same spot. It did several things, however, among which may be mentioned elimination of stalling and spinning and a more or less vertical descent at parachute rates of descent, which permitted vertical landings in still air when a special landing gear was used capable of taking the shock.

To be fair one must look into the bad points of a machine as well as its good points, so here are those shown by the original autogiro. It was difficult to fly and often dangerous to land as, while the wing revolved fast enough to prevent dangerous falling speeds in a vertical descent, it required a considerable amount of forward speed to get it revolving fast enough to fly and climb the ship. This led to most of the accidents as the fixed-wing pilot flying the revolving wing in a wind would overdrift a landing and then wait too long before applying power to get flying speed. Happily, comparatively few of these crash landings were fatal, but they cost the revolving wing much of the confidence which had been gained for it. The original 'giros also had to get the wing revolving by long periods of taxiing, and I can remember the first machine which Cierva brought to le Bourget, taking several turns of the field before it could take off and then flying very slowly for its power.

The American development of the autogiro brought out one important improvement—the power starting of the wing. The engine was clutched to a drive which revolved the wing to flying speed, thus making the machine really a helicopter at the take-off. It could spring into the air for a take off and then maintain the rotation by forward speed. Even with these improvements the French and German governments were not satisfied that the autogiro had the ability to get in and out of the limited areas from which they wished to operate observation machines, nor to hover without change of altitude, so both countries actively pushed the development of the helicopter.

The American Army was skeptical as it had spent much time and money immediately after the last war at McCook Field on an unsuccessful Russian development and was unwilling to continue the expenditures. In the early thirties the aviation world was electrified by the success of a German machine which, flown by a German woman fiier, gave exhibitions in a large building in Berlin stopping, hovering, flying backward and forward, etc. This led to the acceleration of attempts to build helicopters in other countries and the Sikorsky machine here and the Breguet in France are examples of the success being achieved.

The greatest danger inherent in the helicopter was a fast fall in case of engine stoppage, but arrangements are now being made in some designs to have the rotors arranged like those of a 'gyro in case of engine stoppage and thus effect a safe though somewhat rough landing. When the airplane will be used to go from urban buildings to suburban back yards, it will have to be some form of revolving wing with absolute vertical control without forward speed and even capable of backing up, so I expect to see a terrific postwar boom in rotating wing development. Maybe the autogiro designers will convert their machines entirely to helicopters during climb and descent and giros in level flight. Even in occupied France the development is going on; the Sud Est Company, the outgrowth of the nationalization of the Dewoitine company, is building a tailless 300 hp. autogiro.

Freedom

No one realizes more than the writer, who has often watched the planes of all nations landing at le Bourget and then leaving for their respective countries, the necessity for really free air transportation and not the tangled up mess which it was getting to be with agreements of "you can land one in my country if I can land one in yours." The airports of the world must be as free as its seaports and the air over all countries as free as the high seas. Having this in mind I wish to append the following paragraph which has been forwarded to me by my good friend Peter Heldt:

Freedom of the Air

"In discussions concerning the postwar development of international air traffic the term 'freedom of the air' has been used a good deal. The term, however, is rather indefinite, and probably no two persons would agree fully on just what it involves. A British organization, the Joint Air Transport Committee of the British Chambers of Commerce, the Federation of British Industries, and the London Chamber of Commerce, in formulating a suitable definition, has broken it down into three subsidiary 'freedoms' as follows: (1) Freedom of passage, which would permit aircraft to fly over any country without landing; (2) freedom of facilities, which entails the use of airports, weather reports, radio control and other services of all states, provided the aircraft does not engage in any trade arising from or in connection with such landings; and (3) freedom of trade, which would permit airplanes to operate for hire or reward into, out of, or within any other state. These three aspects of 'freedom of the air,' it is pointed out, are progressive; that is to say, if the second is accepted the first necessarily also must be accepted."

Modern Features

To keep the record straight may I point out that rubber covered jettisonable bullet proof fuel tanks were used on the Salmson plane during the last war, cannon were mounted on some of the 220 hp. Hispano Suiza engines used on Spads by several of the French aces and that the cockpit of the British Sopwith Salamander plane was an armor plate box about ¼-in. thick.

Magnesium

It has been surprising to some American designers to find the very great amount of magnesium being used in German military aircraft. Most of this is in the form of castings and forgings and much of it is without heat treatment. The metal seems to suffer little from corrosion and has replaced aluminum at many points.

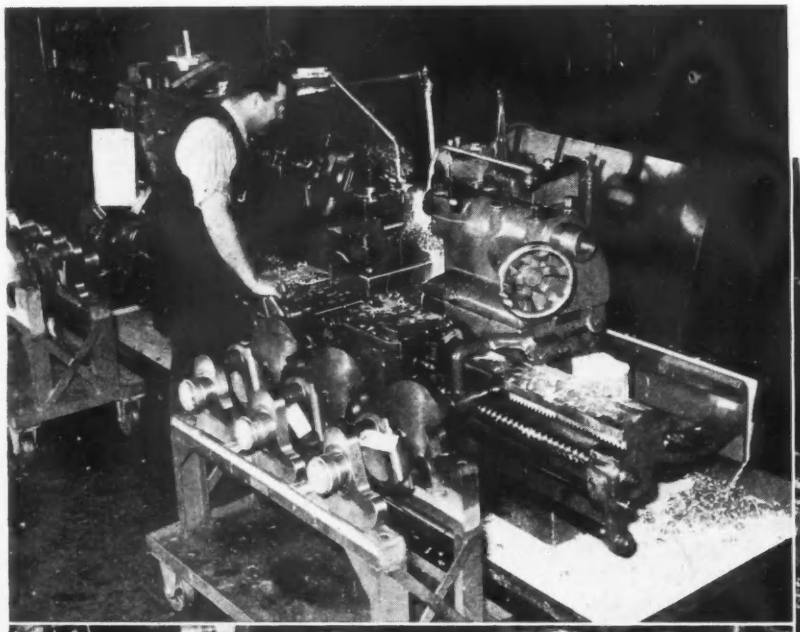
By Joseph Geschelin

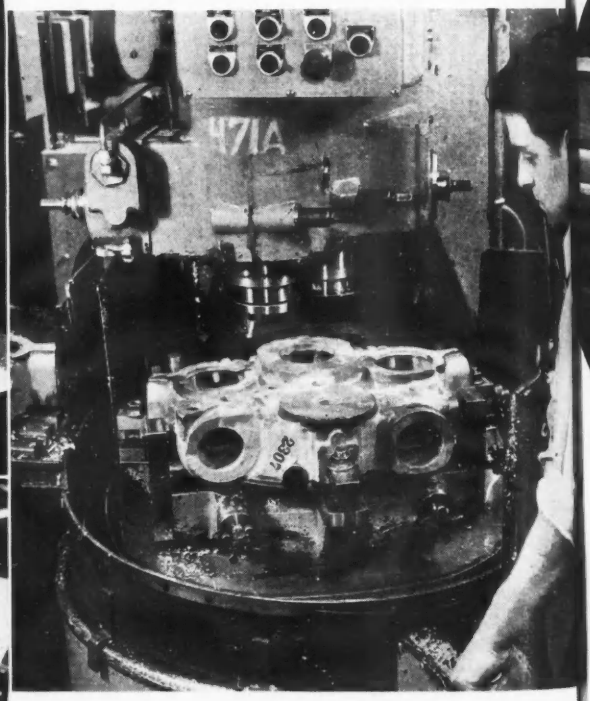
Chevrolet's Unique S

OUTSTANDING examples of complete change-over from peacetime to war production are Chevrolet's Buffalo plants which are engaged in the manufacture of Pratt & Whitney 14-cylinder radial aircraft engines. The facilities of three plants have been coordinated on this project, providing a unique setup by comparison with other plants engaged in building airplane engines.

Now that the story of this accomplishment can be told, note first, that two of the three plants represented Chevrolet's branch plant establishment in Northern New York state. One of these was the Fisher Body and car assembly unit; the other, a new motor and axle division, built about five years ago. The third unit is a new building designed exclusively for the assembly and testing of completed Pratt & Whitney engines.

In the general conception of this





(Above)
Set-up for milling pads on the flat rear case, on a vertical Sundstrand Rigidmil.

(Upper left)
Here is one of the many new LeBlond crankshaft lathes in the Chevrolet airplane engine crankshaft department. A Milwaukee vertical mill may be seen at the extreme left.

(Left)
Versatile Sunnen hand honing machine is used at Chevrolet for many small parts, the honing of the valve roller bore being shown here.

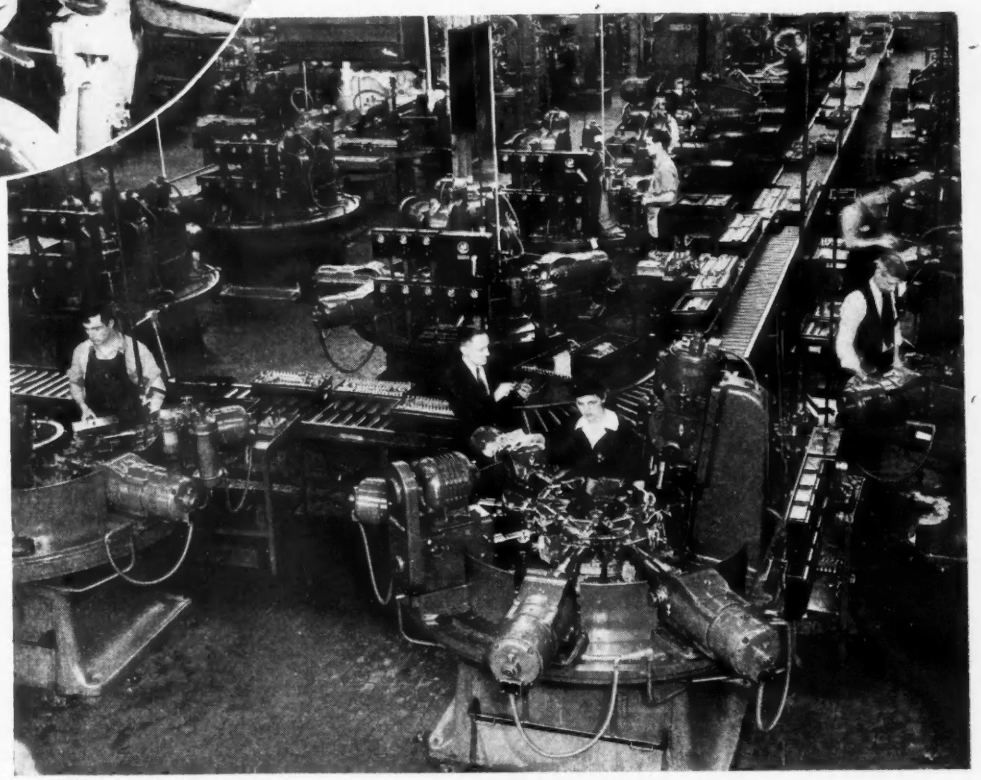
Setup *for Airplane Engine Production*

operation, the two converted plants produce parts of various kinds, feeding these to the new assembly plant. In addition, Chevrolet has enlisted the facilities of Chevrolet plants in other parts of the country for the production of various components and has drawn upon outside sub-contractors as well. The general program of sub-contracting serves not only as an element in decentralization but is indeed the only practical means of meeting the greatly accelerated program demanded of Chevrolet.

To permit of better visualization of this operation, we shall consider each one of the three plants separately. Let us take Plant 2 first. This consists of the original Fisher Body plant, the car assembly building, a smaller car conditioning building, and a parts warehouse. In the days of passenger car manufacture, this unit assembled Chevrolet cars and trucks at the rate of around 45 units per hour for an eight-hour day. The last car came off the line on July 30, 1941.

Even before the last car had rolled off the assembly

This is the Eighty-second in the series of monthly production features

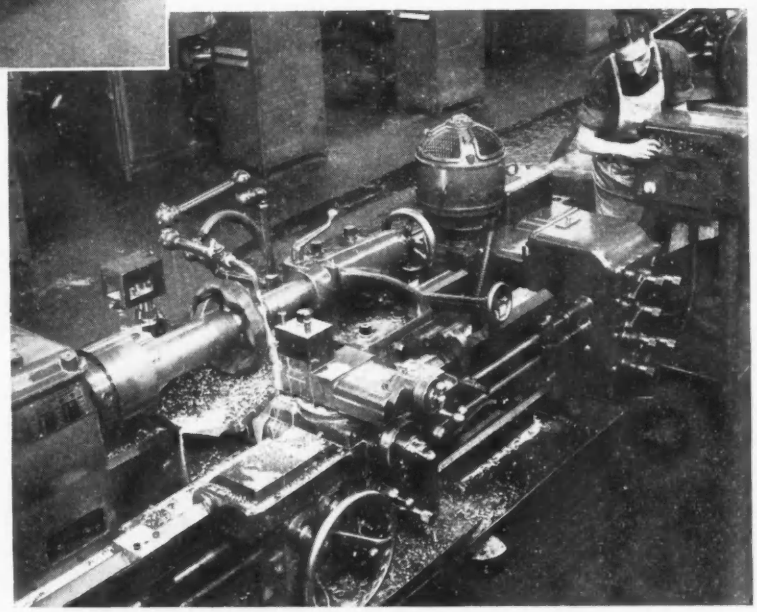


(Above)
Interesting adaptation of the Fellows gear shaper is this operation of rounding the bosses of the articulated rod.

(Right)
View of the rocker arm department in the Chevrolet airplane engine plant with batteries of Kingsbury machines, foreground, and a Footburt surface broaching machine in the background. Note how the entire department is tied together by means of the gravity roller conveyor.

(Left)
This heavy duty monorail conveyor, provided with wood trays to prevent the marring of finely finished surfaces, is used for transporting cylinder barrels through the machine shops.

(Below)
Example of the versatility of the Monarch lathe equipped with a Keller attachment is exemplified by this application for the form-turning of the propeller shaft.



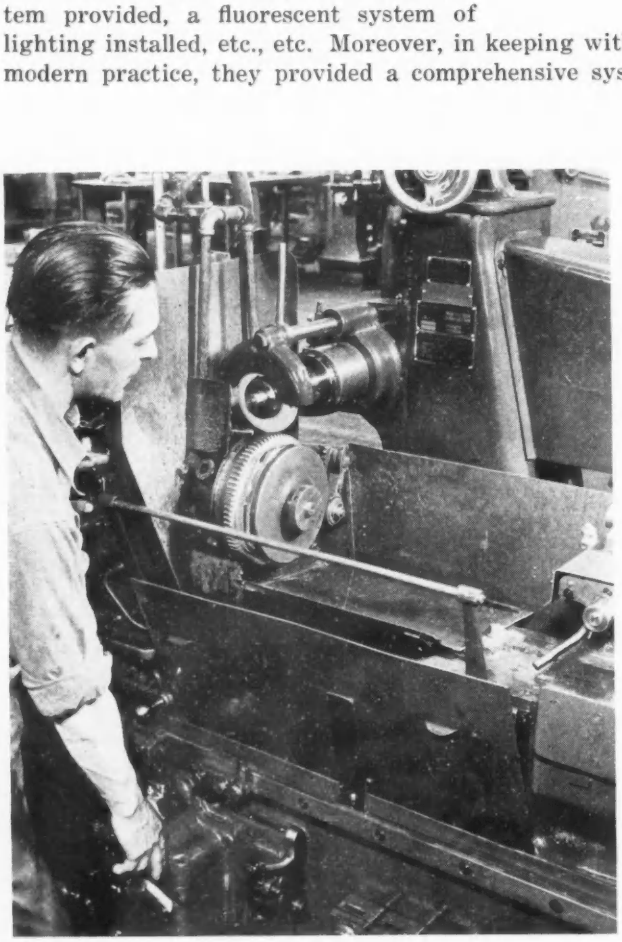
line, the wrecking crew had been at work tearing out the conveyors, paint spray booths, baking ovens, and all of the multiplicity of equipment found in a body and assembly establishment. Meanwhile, the Plant Engineering Department had already prepared its floor plans for the machine shop arrangement. Great skill was employed in adapting the existing floor space to the most efficient layout of machine shops for the production of some 300 different parts of the radial engine.

In the process, the concrete floors were covered with wood blocks, the power installation was converted from 25-cycle current to 60-cycle, a new heating system provided, a fluorescent system of lighting installed, etc., etc. Moreover, in keeping with modern practice, they provided a comprehensive system of overhead bus-duct for the distribution of power to all of the production machinery and tools.

A distinctive feature of these Chevrolet plants is the maximum utilization of materials handling equipment, borrowed from automotive practice, to a degree uncommon in aircraft engine manufacture. Here will be found monorail conveyors; gravity roller conveyors along the machine lines; industrial trucks of many types for interdepartmental hauling, tiering; hoists and cranes.

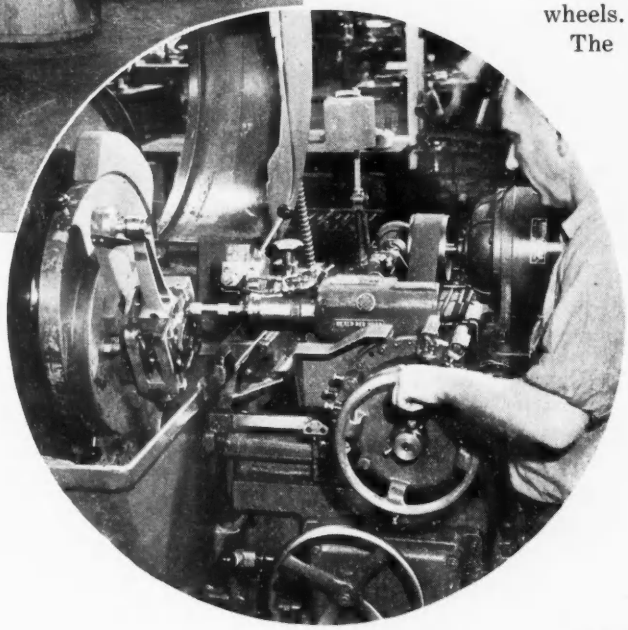
At the outset, this unit was equipped for the production of some 300 parts, including master rods, link rods, pistons, rocker arms, many gears, and small non-ferrous parts and housings. However, as the demand for engines was accelerated, more and more of such parts were sub-contracted, with the result that currently this unit is concentrating upon some 100 parts only.

Among the major parts made in what was the car assembly building are master rods, link rods, pistons, rocker arms, pumps, and gears. Following automotive practice many of the initial operations on the rods are performed by surface broaching, thus eliminating a



Grinding of cam-ring gear teeth is done on a Gear Grinding Machine Co. Geargrind machine—the one shown here being part of a large battery.

(Above)
Part of the equipment in the modern heat treating department in the Chevrolet engine plant is this group of Lindberg draw furnaces.

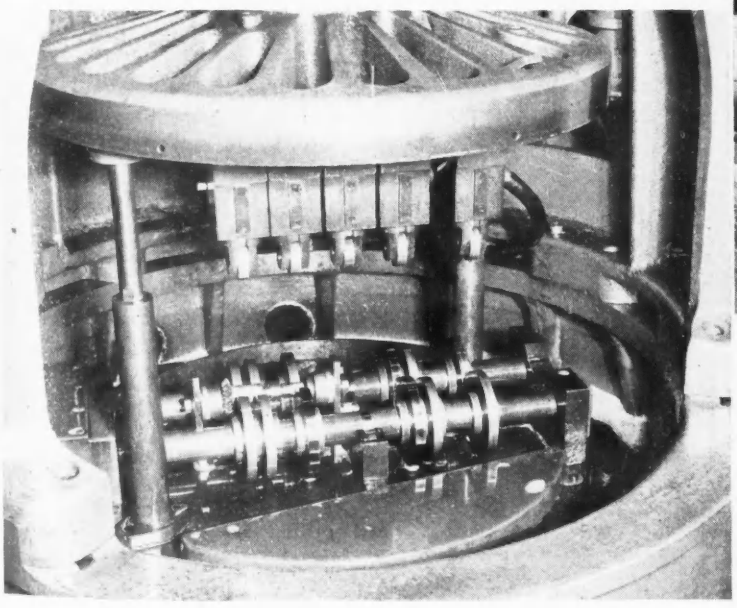


(Circle)
Unique application of a Heald internal grinder is this large No. 172 machine fitted with a double-wheel spindle. This makes it possible to precision-grind bores of different diameters in the front and rear webs of the master rod.

multiplicity of milling machine setups. On link rods, the boss ends are contoured on Fellows gear shapers, while the sides are finish-ground on Thompson surface grinders. A large battery of Cincinnati four-spindle Hydro-Tels is employed both on the link rods and master rods for various contour-milling operations. In addition, there is a battery of Kearney & Trecker milling machines for various other operations on these parts.

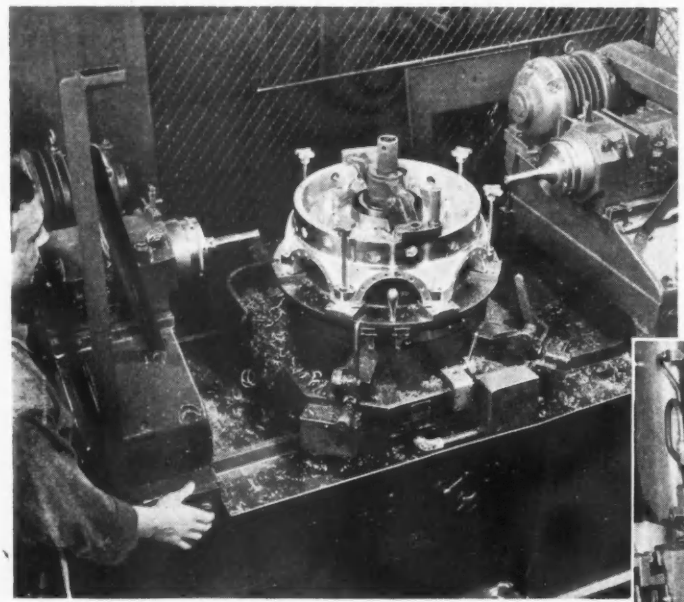
The master rod incorporates a total of some 189 operations, including hand finishing, polishing, inspection, etc. There is a battery of special Snyder machines for contouring the pockets on the master rod. Rather interesting is the use of the Heald No. 172 internal grinder for finishing the knuckle pin bores in the master rod. Although the bore on one side is smaller than it is on the other, both bores are ground simultaneously by the ingenious use of a long and rigid spindle mounting two separate wheels. The secret of this operation lies in the adaptation of a special wheel truing device for dressing both wheels.

The gear department employs Cleveland Rigidhobbers for hob-



(Above)
One of a large group of Barnes honing machines, fitted with Micromatic tools, used at Chevrolet for the honing of cylinder barrels.

(Left)
An unusual piece of equipment at Chevrolet is this Gleason horizontal quenching machine fitted with special roller dies for handling long, slender gears.



(Left)
This is a special two-way Ex-Cell-O precision boring and drilling machine on the front main power section.

(Below)
One of the many special Snyder two-spindle machines used for forming rib sections in the interior of the piston.

bing operations; Fellows gear shapers on internal gears and other gears having shoulder interference; Lees-Bradner thread millers for intermediate spiral gear sections; and the new type Gleason generators for all bevel gears. This department boasts a large battery of Pratt & Whitney gear grinders of two-wheel and single-wheel types for gear grinding operations.

The cam ring is produced in this department, initial turning being done on Bullard Mult-Au-Matics. Intake and exhaust cam contours are rough- and finish-ground on the new Landis hydraulic cam grinders. The cam ring gear section is finish-ground on Geargrind precision grinders.

This department is served by a comprehensive heat treating unit employing gas-carburizing exclusively, using L & N Homocarb furnaces. Gear quenching is done on the well-known Gleason quenching machines employing special roller type dies which make it possible to quench long gear blanks in a horizontal position. Lindberg drawing furnaces are used exclusively.

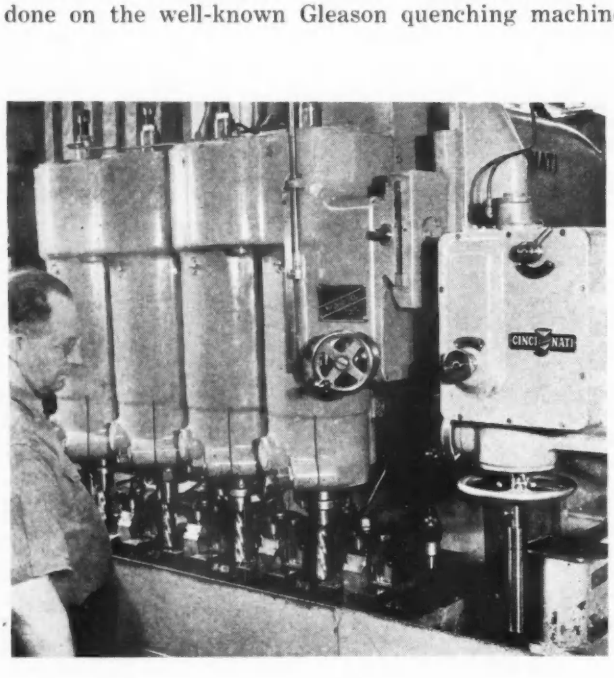
These facilities are supplemented with a comprehensive electro-plating department equipped for plating cadmium, copper, tin, zinc, and lead. Selective hardening of gear blanks is accomplished with the use of a special stop-off lacquer which is sprayed on, then stripped by hand after plating.

Interesting detail of conversion in the heat treating department is the adaptation of the huge enamel storage tanks, formerly serving the Chevrolet paint shop, for the storage and circulation of the quenching medium.

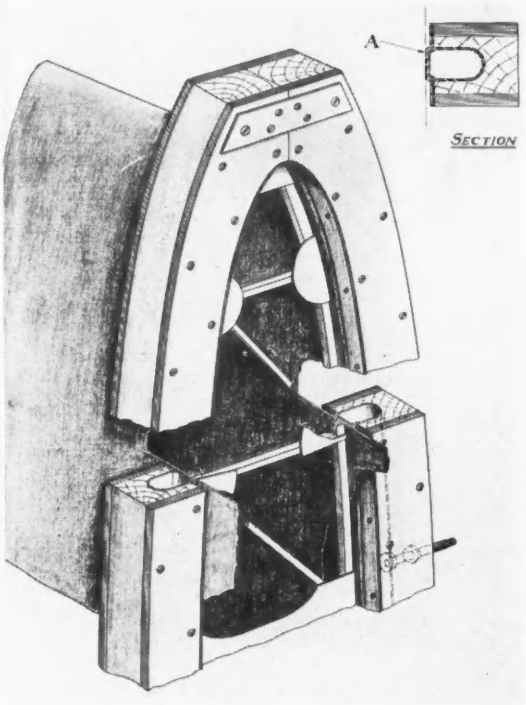
One of the major self-contained departments here is the specialized line for rocker arm production, traversed completely by a gravity roller conveyor system. A highlight along this line is a battery of small Bryant No. 5 internal grinders used for grinding rocker arm bores.

The piston department is replete with Fay automatics for turning and facing, a large number of Snyder two-spindle vertical machines for generating the in-

(*Turn to page* 42, *please*)



Many of the forming and profiling operations on the master and articulated rods are performed, automatically, on Cincinnati Hydro-Tels, of which this four-spindle machine is typical. Shown here is the contouring of master rods.



Sectional view of one of the pneumatic clamps

Pneumatic Clamping Device for Plywood Skins

THE gluing of the plywood skin to the wing and tailplane frames of a wooden aircraft is greatly facilitated by a pneumatic system of clamping the plywood in position developed by the Morris Motor Co., England. It overcomes a difficulty previously experienced of ensuring uniform pressure of the skin on the many ribs and other parts of the framing of the airfoil to which the skin should adhere, a difficulty particularly evident where the airfoil has a narrow pointed section at the leading edge.

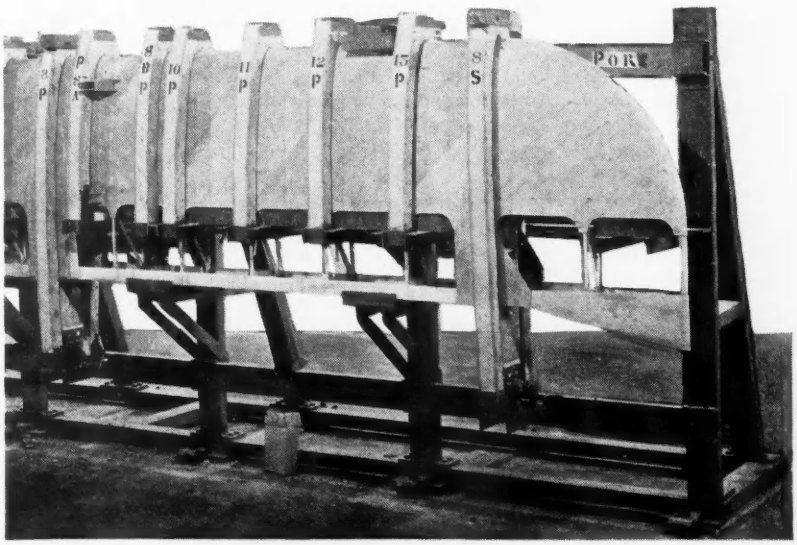
In the Morris pneumatic system the framework of the airfoil, built up by conventional methods, is placed in a skinning fixture of steel, with blocks to support the spar and ribs and with pin locations for the pick-up points at the root end.

Glue then is applied to the framework and to the plywood skin (preformed to approximately the required shape) and the latter put in position and held by a series of hinged locating clamps. These pneumatic clamps are then placed over the rib locations as shown in the photograph, the air pressure supply coupled up and the pressure turned on.

Each clamp (see illustration) consists of a hardwood frame forming roughly an inverted V in outline, though variously shaped internally to the contour of the airfoil at the rib locations. The inner surface is recessed to accommodate an air tube the ends of which are plugged with pieces of solid rubber of appropriate shape. The valve of each tube projects outwardly through the framing of the clamp, near the bottom of one "leg." To prevent the tube from bulging under the edges of the clamp, it is enclosed within the recess by a strip of stout sheet rubber, as shown at A. The tube is not molded to the outline of the V, but consists merely of a straight length of motorcycle tube plugged at the ends.

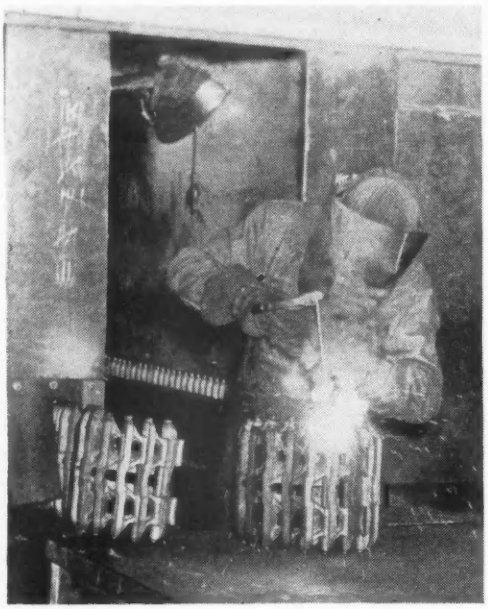
On some airfoil sections the framing of the clamp needs a hinge at the apex of the V, so that it can be opened slightly to allow it to pass over the thickest part of the section and close on to the surface of the skin. The legs of the V in such cases are extended, and when in position are locked to the fixture by pins through the lower ends. At the top, above the hinge axis, is a finger-operated screw to be tightened after the clamp has been secured at the lower ends as mentioned. This arrangement applies to the long clamps.

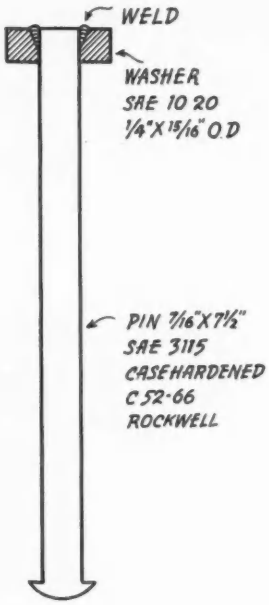
Air pressure is taken from a steel pipe running along the top member at the back of the fixture and coupled to the air pressure line. From the steel pipe, rubber leads extend to the valves. A pressure of 30 psi is maintained.



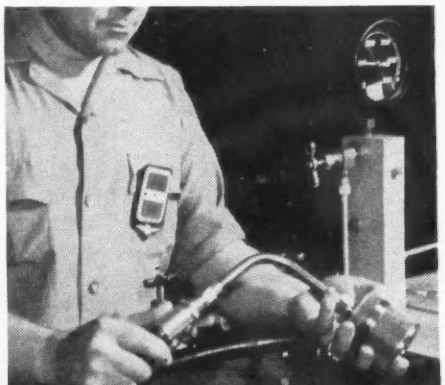
Tailplane with plywood skin held in place by pneumatic clamps while glued joints are hardening

Short

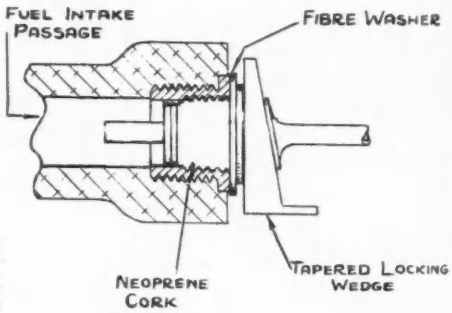




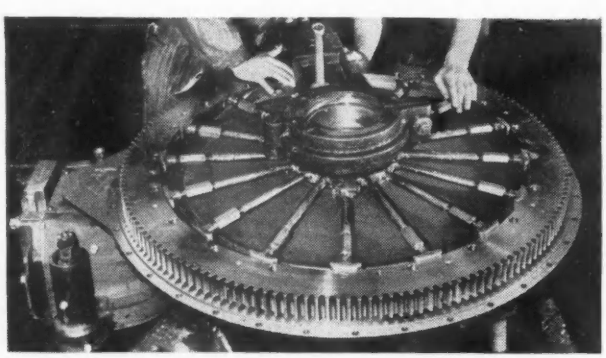
(Upper left) Increasing the electrode size and the welding current enabled the Auto Specialties Mfg. Co. of St. Joseph, Mich., to boost the output of tank track sections from 10 to 24 sections per hour. Following recommendations of The Lincoln Electric Co., electrodes were increased from 3/32 in. and 1/8 in. sizes to 3/16 in. size and the current from 200 to 300 amperes. The job consists of welding washers on the ends of 7/16 in. case-hardened pins. There are 20 of these pins in a section of tank track. Originally the plan was to upset or head over the end of the pin, but it was found impracticable to do this due to the hardened condition of the pin. It was, therefore, decided to weld on a washer of 1/4 in. thickness and 11/16 in. OD as shown in the sketch accompanying the photo.



(Right center) Douglas Aircraft Co. has found that pretesting of brake poppet valves saves considerable time by preventing the setting up of complete brake units with valves that do not seat correctly. Now in use at its Long Beach plant is this special apparatus that was developed there for that purpose. Valves are placed in the chamber and a high oil pressure applied to test them for leakage.

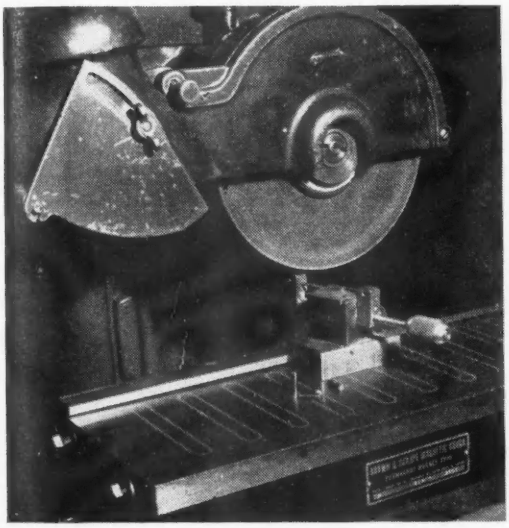


(Right) After an aircraft engine has passed through its test and is being prepared for shipment, the carburetors are flushed with oil to remove any gasoline adhering to the diaphragms and the inside walls of the carburetor body. Originally, the oil line used for the flushing operation was connected to the fuel intake by means of a threaded coupling. August Pepka, an assembler in the Aircraft Engine Division of Packard Motor Car Company, suggested a new type of coupling consisting of a tapered Neoprene plug and a tapered locking wedge. The plug is inserted into the threaded intake passage as shown in the drawing, and then tightened by means of the tapered wedge. The pressure created by the wedge forces the Neoprene into the threads so it forms a tight seal. The new method reduces the time required to make and undo the connection by about 50 per cent.



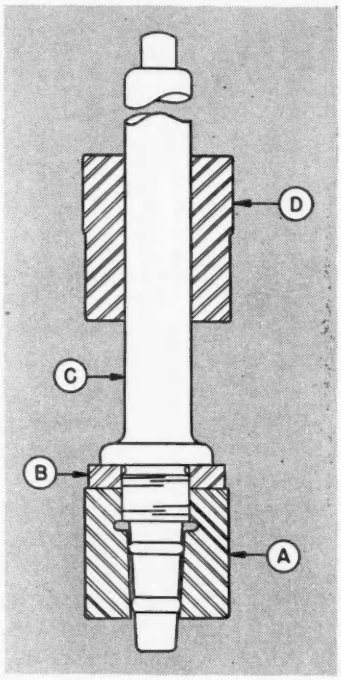
(Left) Shown in the fixture is the traversing gear rack of the 90-mm. anti-aircraft gun—the gear upon which the gun carriage revolves. To ensure that the gear is perfectly round, Fisher Body Division of General Motors developed this fixture, which serves to "stretch" the gear into a true circle. It is said that in this process the steel can be stretched out as much as 0.006 in.

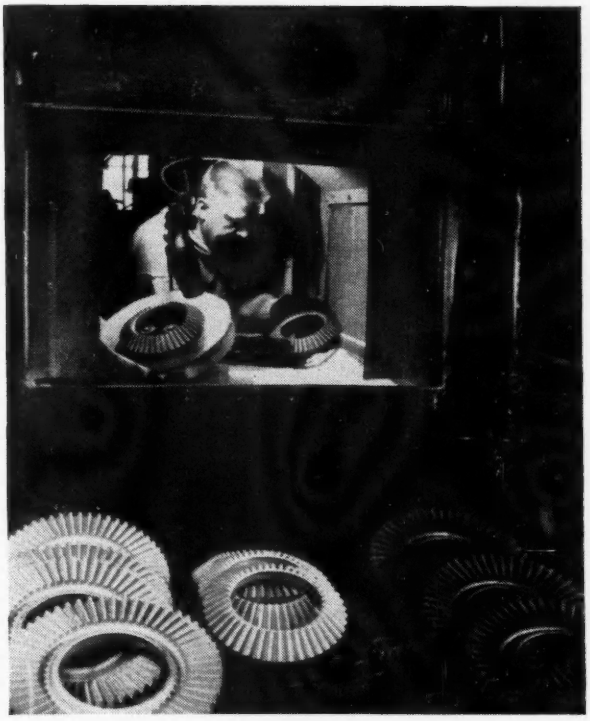
Cuts



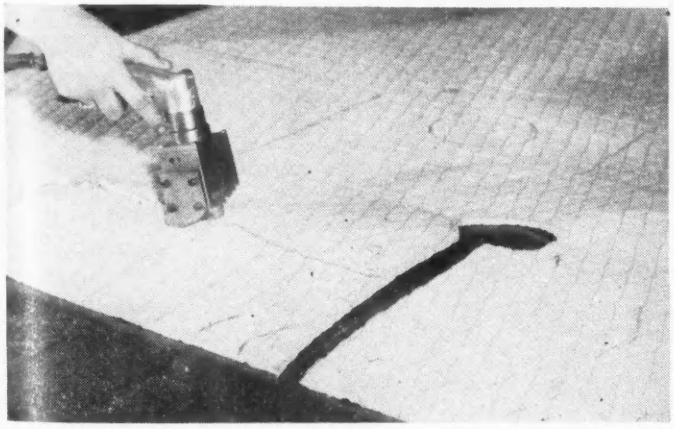
(Above) To avoid the cost of setting up a centerless grinder for small runs, Westinghouse Electric & Mfg. Co. engineers built this fixture, which permits grinding of parts to 0.0005 in. tolerance on a tool room grinder. The part to be ground is placed in the round slot, and as the chuck holding the fixture passes back and forth under the grinding wheel, the part is rotated in the slot much in the manner of a centerless grinder. A handle at the front of the fixture operates two fingers which move the part in the slot under the wheel.

(Right) Essentially an expansion tool, this General Electric production tool is said to quickly and accurately ream holes in places that are difficult to reach with scrapers. When it is set up for production, the unit is first disassembled, an operation that reduces the diameter about 0.002 in. The reamer A is inserted in the hole to be finished, and tightened against washer B by a twist of arbor C. This expands the tool to the proper diameter and reams the hole to the correct tolerance in one turn. Part D is a guide member. Cutter wear is taken care of by decreasing the thickness of the washer. This permits the taper portion of the arbor to enter the cutter farther. A 0.001-in. reduction of the washer thickness will expand the reamer 0.0001 in.





(Above) Reduction gears for Pratt & Whitney aircraft engines, built by Chevrolet, formerly were hand-polished—a tedious process. Now a sand-blasting process approved by the War Department develops a hard surface and eliminates the need for hand-polishing. Sand-blasting saves 90 per cent of the time normally required for hand-polishing.



(Above) This pneumatic-operated cutter was developed at the Consolidated Aircraft plant for cutting Seapack fabric and sound insulation material. Its principal feature is that an operator can cut on sharp corners as well as along curved outlines. Power is supplied by an Ingersoll-Rand pneumatic motor No. 00AK, to which is attached a special blade.

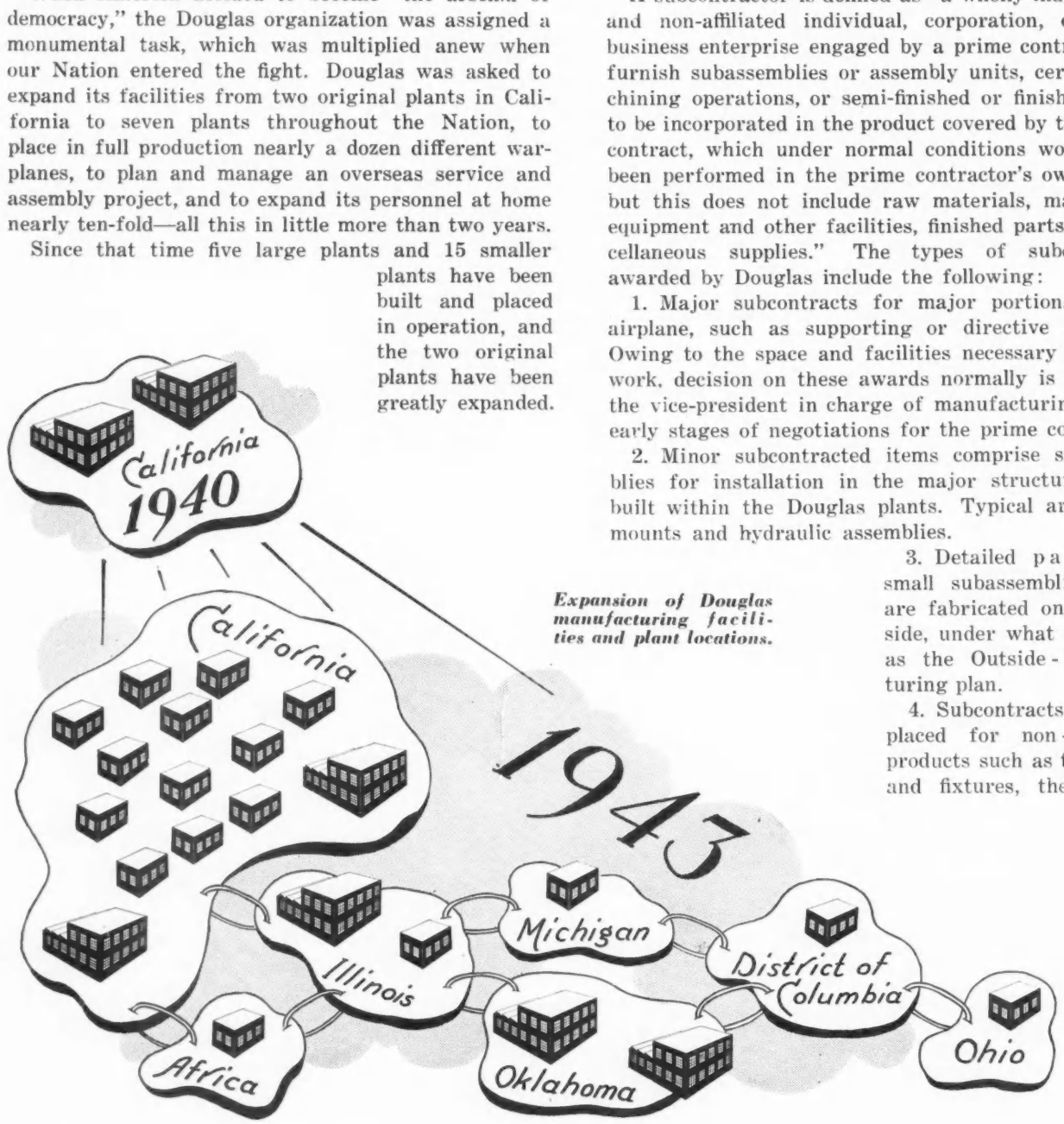
Douglas Subcontracting

By Frederic W. Conant
Vice-president in charge of manufacturing
Douglas Aircraft Co., Inc.

WHEN officials of aircraft manufacturing concerns made a tour of the manufacturing plants on the Pacific Coast a short time ago, they were at each plant given details of some development of which the management felt particularly proud or in respect to which it excels in the industry. At the Santa Monica plant of Douglas Aircraft Co., Inc., they were told about the methods of subcontracting developed by the company and of its part in the pooling of production facilities.

When America decided to become "the arsenal of democracy," the Douglas organization was assigned a monumental task, which was multiplied anew when our Nation entered the fight. Douglas was asked to expand its facilities from two original plants in California to seven plants throughout the Nation, to place in full production nearly a dozen different warplanes, to plan and manage an overseas service and assembly project, and to expand its personnel at home nearly ten-fold—all this in little more than two years.

Since that time five large plants and 15 smaller plants have been built and placed in operation, and the two original plants have been greatly expanded.



Expansion of Douglas manufacturing facilities and plant locations.

A dozen different models are now rolling out of these plants. The overseas project already is functioning successfully, despite great obstacles. The army of Douglas workers has grown to nearly ten times its original number, and new employes are being trained and absorbed to provide for this expansion and to replace men inducted into the Army.

A subcontractor is defined as "a wholly-independent and non-affiliated individual, corporation, or other business enterprise engaged by a prime contractor to furnish subassemblies or assembly units, certain machining operations, or semi-finished or finished parts to be incorporated in the product covered by the prime contract, which under normal conditions would have been performed in the prime contractor's own plant; but this does not include raw materials, machinery, equipment and other facilities, finished parts, or miscellaneous supplies." The types of subcontracts awarded by Douglas include the following:

1. Major subcontracts for major portions of the airplane, such as supporting or directive surfaces. Owing to the space and facilities necessary for such work, decision on these awards normally is made by the vice-president in charge of manufacturing in the early stages of negotiations for the prime contract.

2. Minor subcontracted items comprise subassemblies for installation in the major structural units built within the Douglas plants. Typical are engine mounts and hydraulic assemblies.

3. Detailed parts and small subassemblies often are fabricated on the outside, under what is known as the Outside-Manufacturing plan.

4. Subcontracts also are placed for non-airborne products such as tools, jigs and fixtures, the render-

System

ing of services, and maintenance and construction.

Scope of Subcontracting

Since July 1, 1942, Douglas has awarded subcontracts of all types involving approximately $275,000,000. In many cases the "Mountain came to Mohamet," Douglas going far afield to tap manpower reservoirs in small towns by assisting local firms to manufacture parts or subassemblies on a subcontract basis. These awards are spread among some 300 principal subcontractors, and at least 1500 lesser subcontractors. This utilization of resources is further extended to a degree that cannot even be computed. For instance, in one case it was learned that a subcontract had been placed for a valve involving 20 different parts. This single subcontractor had in turn brought in seven additional subcontractors to participate in its manufacture.

It was discovered that the "know how" of those in other industries, despite their skill and experience, was in most cases a separate and distinct quality that had to be bridged and coordinated with the characteristics of aircraft technique before production could begin. Accordingly, several or all of the following "show how" steps were taken to assist subcontractors in mobilizing their facilities for the fabrication of airplane assemblies:

1. Subcontractors were invited to send key personnel to the Douglas plants. They were given access to all manufacturing facilities, and provided with a groundwork in the methods and techniques for the particular work their firm was to do.

2. A Material Office was established in Detroit with an organization of engineering, inspection and tooling experts. Under the supervision of this office, representatives were placed at the plant of each major subcontractor to assist him in every way possible.

3. Through the Eastern Office, representatives at subcontractors' plants, and through their personnel who were trained in Douglas plants, the special characteristics of airplane manufacturing were brought home to subcontractors. They were shown the necessity for precise weight control, careful handling of materials, why dents and scratches must be avoided, the necessity for cost control, the importance of accu-

(*Turn to page* 135, *please*)

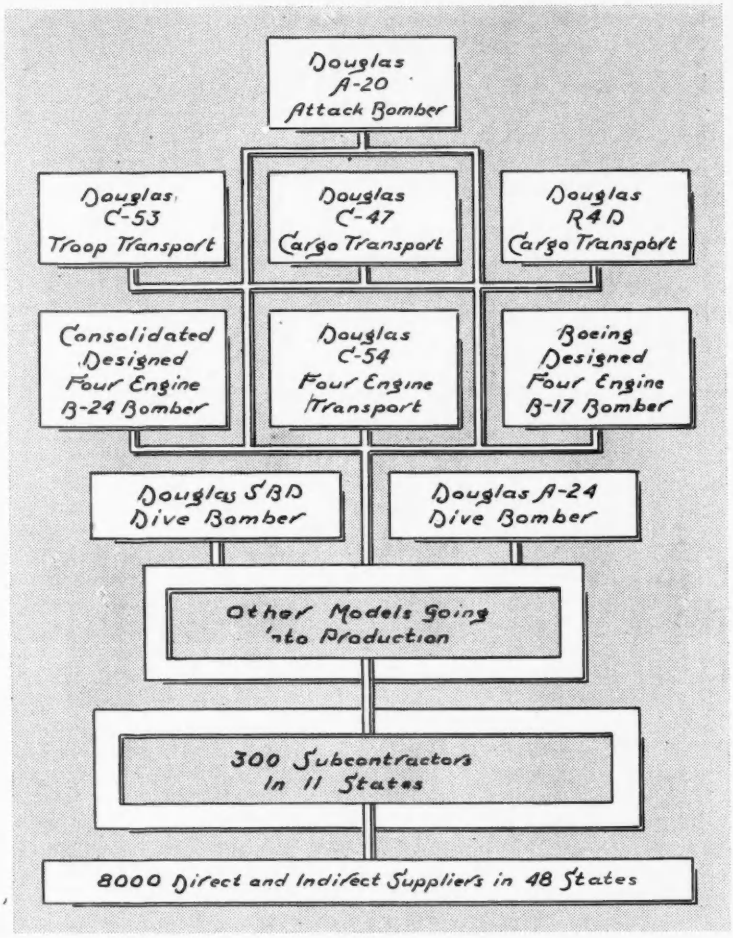
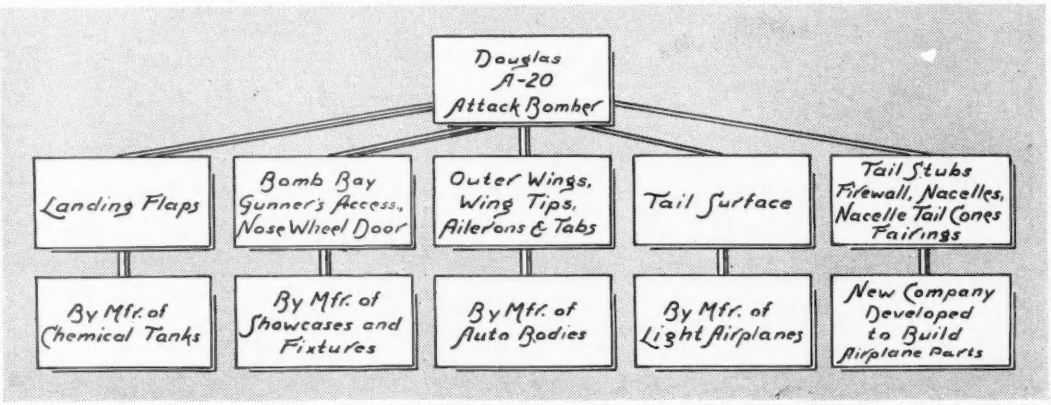
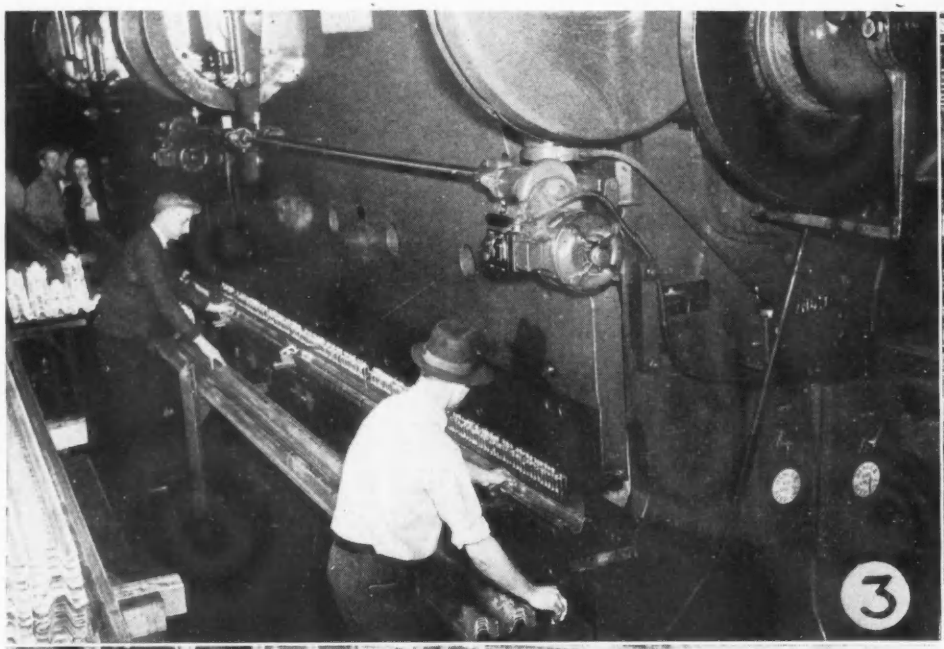
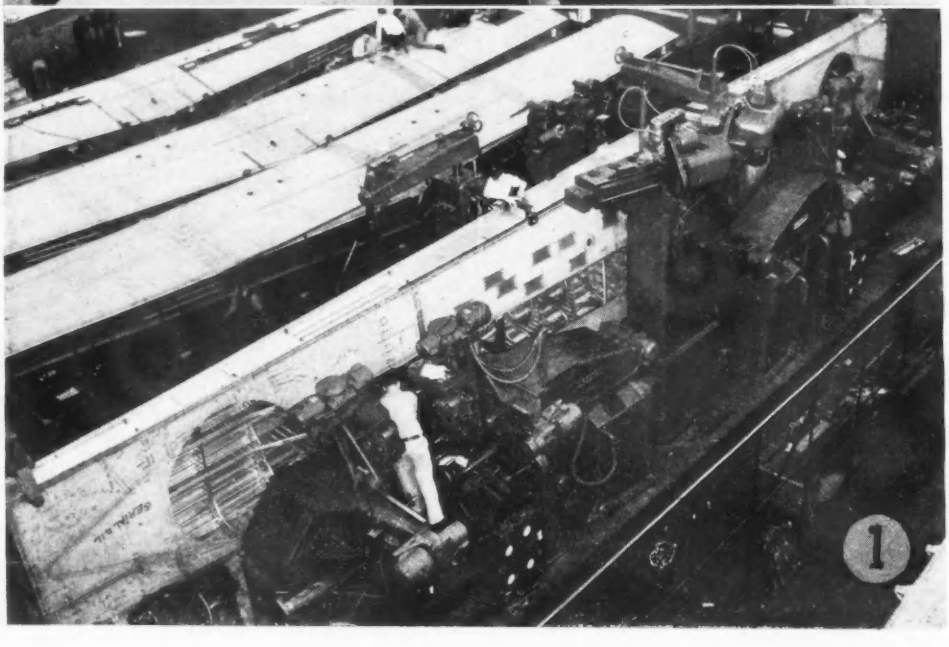


Chart of warplane models in production at Douglas plants, subcontractors and suppliers.



Typical subcontracting setup for warplane production.





By Joseph Geschelin

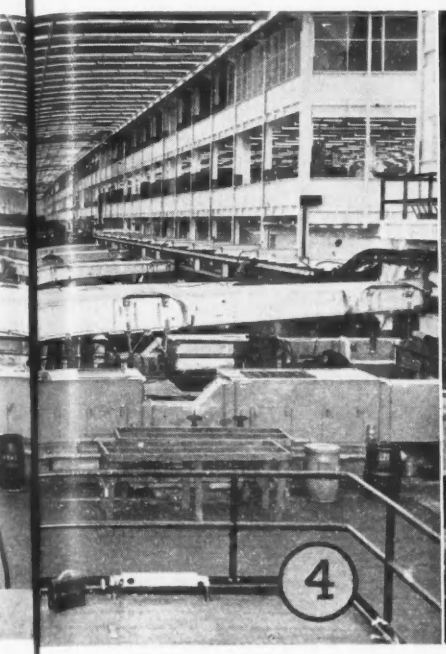
5. Close-up of one of the bat tery of Sciaky welding ma chines at Willow Run, employ ing the principle of refrig erated welding electrodes.

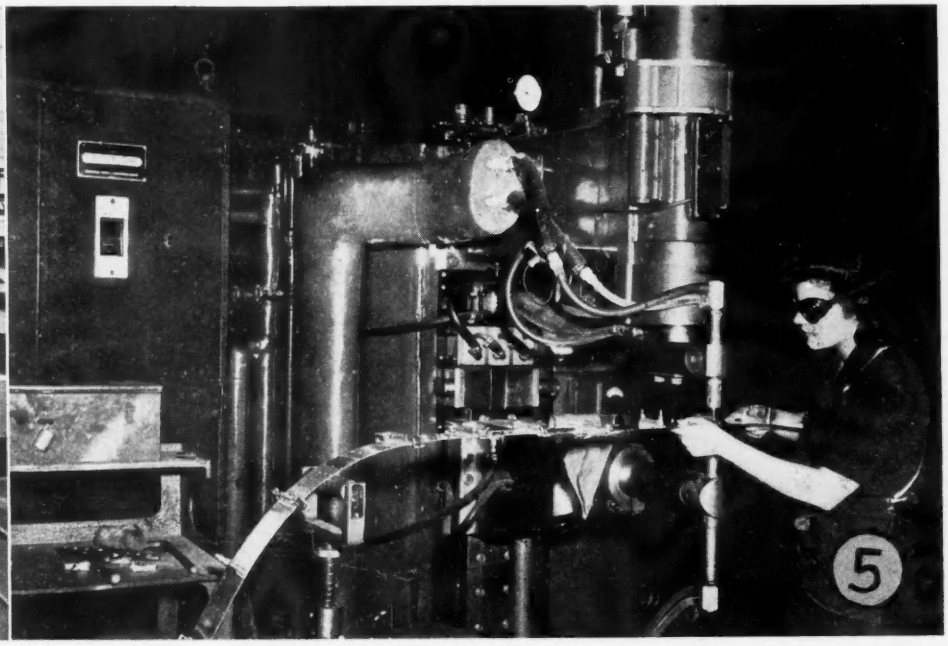
4. Backbone of the B-24—th huge center wing section— ready for the final assembly operations. It is transported on rails on each side.

3. Cincinnati press brake i used for pre-punching rive holes in ribs and stringers. Upwards of 200 rivet holes are punched at one time with the use of standard Strippit punches.

2. Here may be seen the final stages of aft fuselage assembly. From this department, the unit is ready for transfer either to the final assembly line or for shipment to outside assembly plants.

1. Engine mounts, for the four engines on the center wing sec tion, are milled, drilled, and bored, to precise alignment on this integrated Ingersoll ma chine, combining milling and drilling equipment. This view enables one to visualize the problem of machine alignment required to handle the exacting operation.





Production Operations at *Willow Run*

INTEGRATION of a life-time of experience in motor car building of the Ford organization with the specialized know-how of Consolidated Vultee Aircraft Corp. in building huge four-engined bombers has combined to make Willow Run the most remarkable bomber operation of its kind. Starting with the engineering and manufacturing background already possessed by the Consolidated organization, Ford applied the wealth of experience gained in the mass-production of automobiles to the development of manufacturing techniques and the design of tools and assembly fixtures equal to the task of creating the greatest output of big bombers that the world has ever known.

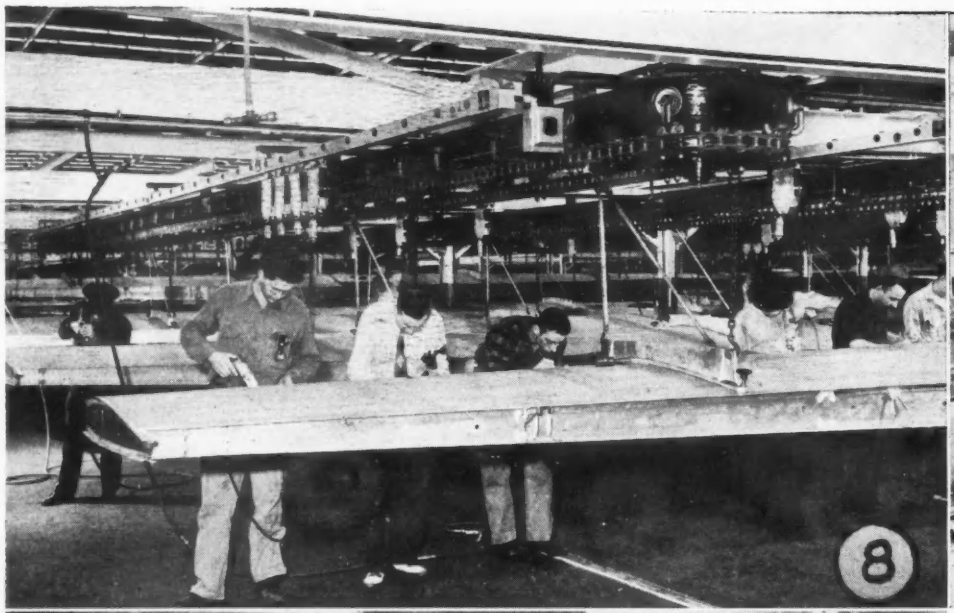
It is to the everlasting credit of the airframe industry and to Consolidated, in particular, that Ford was given whole-hearted cooperation in achieving this objective. All of the background of the Consolidated organization, which had already achieved greatness in the mass-production of huge bombers and Navy flying boats, was given freely. These established principles were then translated into another form by Ford engineers who studied the Consolidated setup and impressed upon it the imprint of Ford methods.

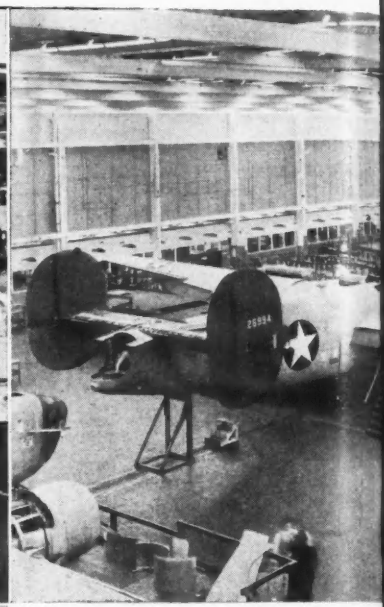
It is common knowledge that, originally, the Ford Willow Run plant was conceived as a source of major sections of the airframe to be supplied to outside assembly plants operated by Consolidated and Douglas. However, even before this plan could be frozen, Ford was directed to increase the scope of Willow Run to encompass facilities for the manufacture of complete bombers as well. Accordingly, the operation today is that of an integrated bomber production plant, making enough of the major sections of the ship to take care of several outside assembly plants as well as its own assembly lines.

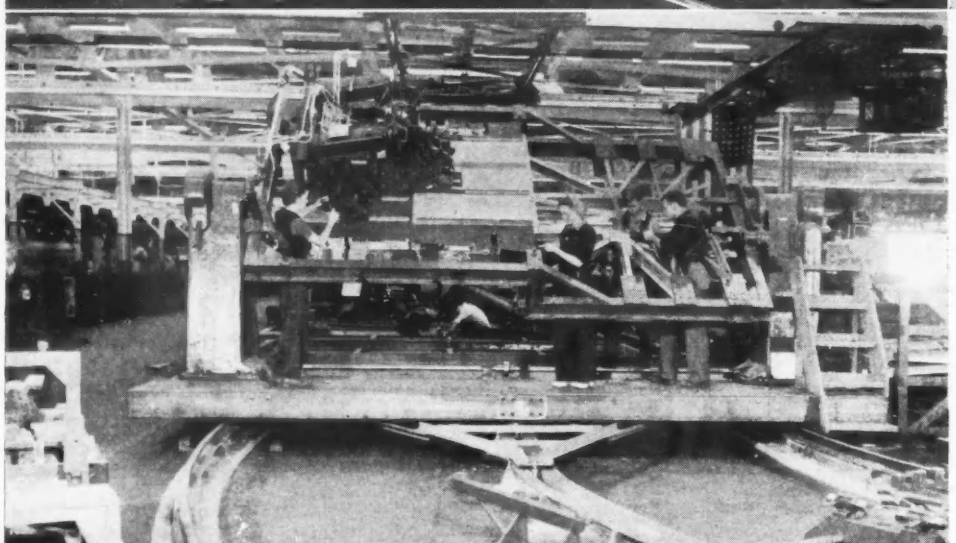
To this end, all manufacturing operations proceed at an established rate right up to the major sub-assembly stages. At this point, the parts are routed either for shipment to the outside or for the Willow Run assembly department.

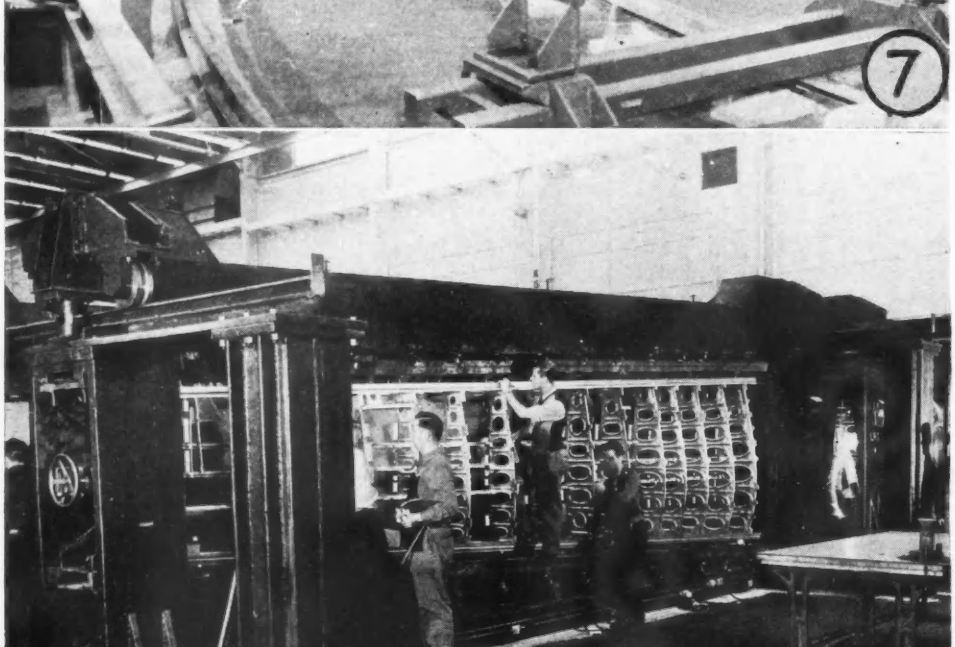
Coming to the plant itself, we find an immense factory organization under a single roof, constituting the largest plant of its kind at the time it was placed in operation. In the interest of economical mass production, the plant area has been logically subdivided into sections of self-contained manufacturing activity. One large section is devoted to machine shop operations, including a large press shop, a draw bench department, and machine shop for metal cutting operations on forgings and a variety of other parts. Another section contains an excellent tool and die shop equipped with the latest types of machinery such as Cincinnati Hydro-Tels, Keller die-sinkers, etc. The major part of the plant, however, is devoted to the fabrication of airframe sections, the building up of sub-assemblies, and the final assembly.

Reflecting modern automotive practice, Willow Run exemplifies the most advanced array of materials handling devices known to the art. For example, there is a long, continuous monorail conveyor used for transporting sheet metal parts from the press shop to the various assembly departments. When fully extended, in the near future, this conveyor will have a length of









8000 ft. Outer wings are outfitted on an overhead conveyor line. The huge center wing assembly is completed on an overhead rail conveyor. The pilot's floor for the fuselage assembly is integrated on a huge merry-

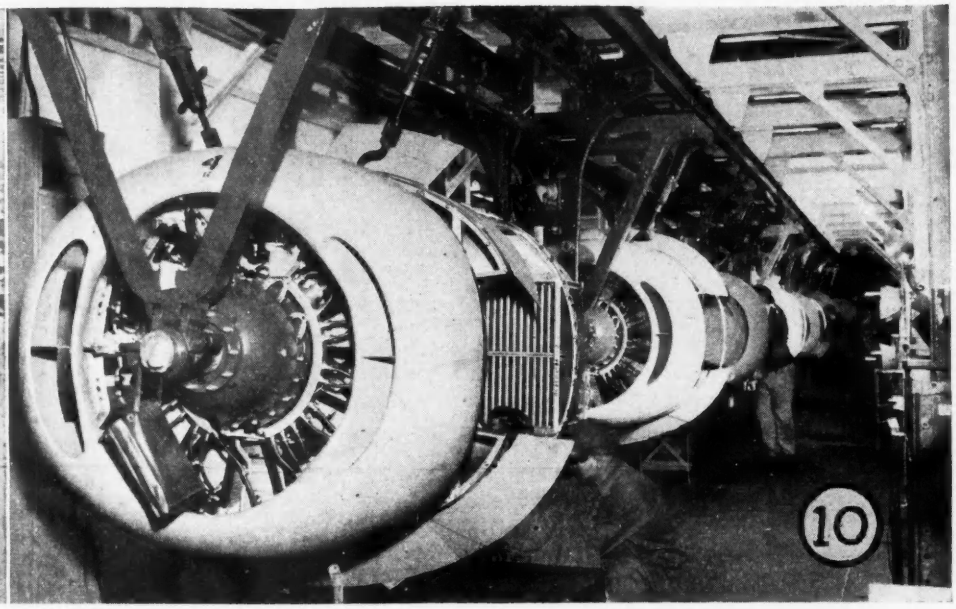
10. Perspective of the engine dress-up line. Engines traverse this department on a closed overhead monorail conveyor. Note the new elliptical cowling that is being installed on Liberators.

9. General view of bombers on final assembly line. In the foreground is one of the assembly stations, showing the detail of an assembly platform.

8. Final assembly of outer wing sections is completed while the work is suspended on a low hung monorail conveyor.

7. One of the assembly stations on the merry-go-round conveyor on which are built the pilot's floor assemblies. The huge fixture is of trunnion-type permitting the entire platform to be tilted for the convenience of the operators, as shown in this view.

6. Close-up of one of the massive wing panel fixtures. Note the rolling overhead beam which slides over to one side to permit removal of the finished work.



go-round conveyor. Final bomber assembly operations are handled with the ship moving along on its own landing gear, progressing from station to station by means of a mechanized chain conveyor bedded in the floor. In addition, many of the heavy lifting and transporting tasks are accomplished with cranes and hoists. Inter-departmental hauling of parts and equipment is done with a fleet of industrial trucks of a variety of makes and types.

Among the major activities, apart from airframe assembly work, is the welding department. This handles a great variety of spot-welding operations on aluminum, using the familiar Taylor-Winfield Hi-Wave and Sciaky "Stored Energy" welding machines equipped with electronic controls. Not content with conventional practice, Ford has done some outstanding experimental work with the refrigeration of welding electrodes. This program holds much promise for future development, although current applications have been limited by many considerations.

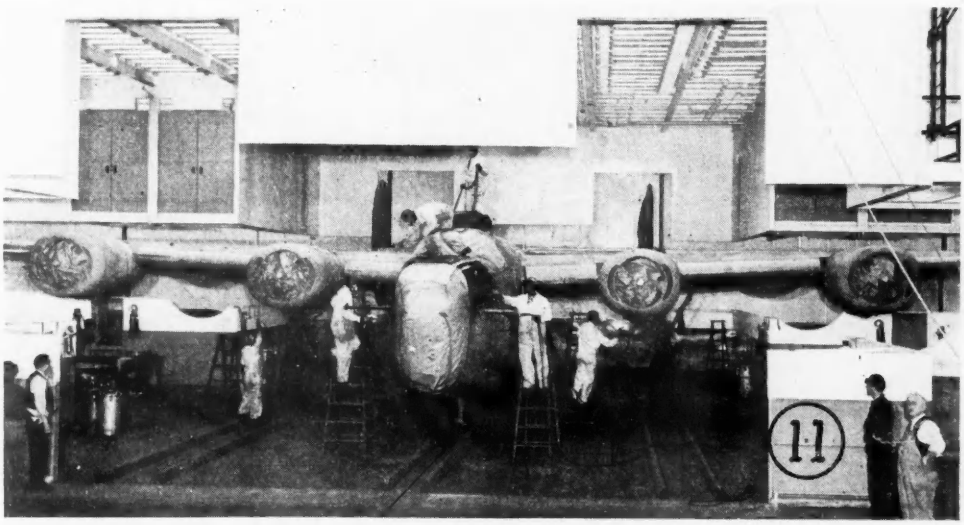
Let us now touch briefly on some of the major manufacturing activities. Starting with the manufacturing section, there are the Yoder draw benches which produce ribs, stringers and other roller sections.

The press shop, containing some 200 presses of many types and makes, features a huge Cleveland press with a bed 208 in. in length, a battery of Bliss Hydro-Matic presses, two 1000-ton Lake Erie hydraulic presses, and two 1000-ton H-P-M hydraulic presses. This department produces the formed and stamped parts for the entire plant. Completed parts are inspected 100 per cent, then hung on the long monorail conveyor for distribution along the assembly departments.

An unusual feature of many of the huge fixtures for skin section assemblies is the use of electrically-operated elevators, fore and aft of the fixture, providing a movable platform for the operators so that they will always be in a position convenient for riveting and fitting.

Backbone of the Liberator, the center wing section, is easily the most impressive airframe unit made here and occupies the center of the stage of operations.

(*Turn to page* 54, *please*)



11. View of interior of gigantic spray booth in which the entire ship is painted. A series of baffles, conform roughly to the profile of the ship so as to reduce the path of fumes and over-spray, thus improving working conditions.

Construction and Equipment of the

Part Two
Part one appeared in the May 15 issue

Focke-Wulf FW190-A-3 Fighter

Engine Mounting

A steel tubular welded construction, the engine mounting is of novel design in that the circular mounting ring, to which the engine is attached through ten rubber bushes, is used to form a reservoir for the hydraulic fluid, including that for the engine master control unit.

Cockpit and Emergency Exit

Cockpit hooding is neat and visibility from the cabin is very good, despite the front glass sloping back at a very acute angle (63 deg from vertical). The side panels are also of flat glass, but the sliding rear part of the hood is formed of a single sheet of molded transparent material, so that the view to the rear is also good.

The sliding hood can be jettisoned by the explosion of a cartridge, which is caused by depressing a lever near the hood-winding handle. The cartridge is stowed on the top deck of the fuselage just aft of a luggage locker, and its function is to break the tubular guide and thus destroy the anchorage of the hood.

Cylinder and Oil Cooling Systems

Although in general the engine of this machine closely resembles that of the Dornier 217 (the BMW 801A) described in AUTOMOTIVE AND AVIATION INDUSTRIES of Oct. 15 and Nov. 1 last, and has its cooling air taken in and passed through the cowling by a 12-bladed fan, air flow is not controlled as in the Dornier installation of the 801A by sliding gill rings, though there are the same close-fitting cylinder and head baffles, the latter ducted in the crown to facilitate front head cooling of the rear bank of cylinders and rear head cooling of the front bank. Both air entry and air exit slots are of fixed dimensions. Most of the air leaves the cowling through three vertical slots on each side of the power unit just forward of the bulkhead, the average size of each slot being 15 in. x 1 in. Some of the air also escapes from the cowling at the exhaust slots. The cooling air flow, therefore, is dependent upon engine and flying speed, in contrast to the Dornier installation.

Another difference lies in the oil cooling system, for in this case the circular oil tank and cooler are mounted co-axially in the nose of the cowling. The cooler is a conventional cellular type having tubes with hexagonal openings and its estimated frontal cellular area is 260 sq in. The cooling air passes through the fan, reverses direction and leaves through the front gill, which has a fixed annular gap of approx. 7/8 in., except at that part coinciding with the dummy portion of the cooler, where the gap is closed.

Fixed to the bottom of the oil cooler and having connections to both cooler and tank is a thermostat, which regulates the quantity of oil passing through the cooler and thus controls engine oil temperature.

Induction System

Air is taken from the rear of the fan by two faired ducts forming bulges on each side of the cowling and leading to either side of the double entry supercharger. From an external comparison with the BMW

(*Turn to page* 60, *please*)

General Summary

Weight Summary

	lb
Aircraft complete (with all fixed equipment except guns)	6544
Pilot and parachute	200
Fuel (115 Imp gal)	860
Oil (10 Imp gal)	96
2 M. G. 151 guns	196
Ammunition for above (200 x 2 rounds)	200
2 M. G. F. F. guns	126
Ammunition for above (55 x 2 rounds) and magazines	90
2 M. G. 17 guns	56
Ammunition for above (1000 x 2 rounds)	142
Radio Equipment	70
Tool weight, loaded	8580 lb

Flaps

Type	Split
Maximum angle	60 deg
Flap area/S	0.092
Flap/local chord:	
inner end	0.16
outer end	0.21
Flap span/2a	0.45
Central cut away span/2s	0.09

Aerodynamic Data

GENERAL

Weight during trials	8500 lb
Gross wing area (S)	203 sq ft
Estimated power (static 1.35 ata, 2450 rpm, 14,000 ft)	1600 bhp
Power loading	5.36 lb/bhp
Wing loading	42.3 lb/sq ft
Span loading	7.21 lb/sq ft
Propeller diameter	10.86 ft
Gear ratio	0.54

WING

Area gross (S)	203 sq ft
Area net	177 sq ft
Span (2s)	34.5 ft
Mean chord (c)	5.88 ft
Aspect ratio	5.87
Dihedral	5 deg
Sweep back of ¼ chord line	2.5 deg
Chord root	7.5 ft
Chord tip	4.05 ft

Longitudinal Control

Gross tailplane area (S')	31.6 sq ft
Total elevator area/S'	0.38

LONGITUDINAL CONTROL—continued

Elevator angle, down	26 deg
Elevator angle, up	31 deg
Type of balance	Shielded horn
Percentage balance	9.1
Stick gear (deg./in.)	4.1
Tail volume co-efficient	0.45

Directional Control

Gross fin and rudder area (S")	24.3 sq ft
Rudder area/S"	0.315
Fin and rudder volume co-efficient	0.134
Rudder angles	±16 deg
Type of balance	Shielded horn
Percentage balance	4.6
Pedal gearing (deg/in.)	6.0

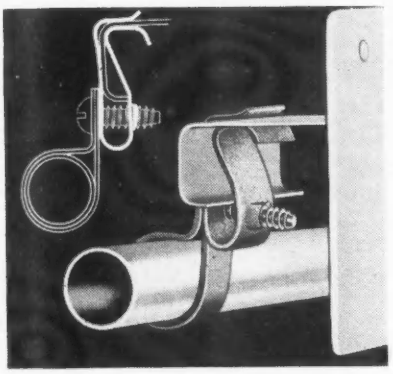
Lateral Control

Type	Frise
Aileron area (total)	20.1 sq ft
Aileron area/S	0.099
Aileron/chord/local chord	0.295
Aileron span/2s	0.43
Percentage balance	28.8%
Aileron angles	±17 deg
Stick gearing (deg/in.)	3.2

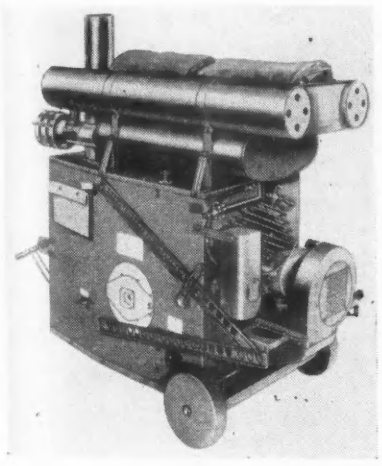
New Products for Aircraft

Aircraft Speed Nut for Rolled Sections

Tinnerman Products, Inc., Cleveland, Ohio, is introducing a Speed Nut for rapid assembly of conduit, piping and wire harness to rolled sections or stringers in aircraft. This Speed Nut No. 6337 is made of special aircraft spring steel with a zinc metal spray finish. It snaps into place and when the screw in the Speed Nut is tightened the legs are forced toward each other to give a firm spring tension grip. The unique design eliminates the need of drilling holes in the stringers or rolled sections. The new Speed Nuts are made for 8Z and 10Z sheet metal screws and are designed for use on various sizes of "Z" stringers.



Aircraft Speed Nut No. 6337



Herman Nelson Self-Powered Heater

A Self-Contained Portable Heater

The Herman Nelson Corporation, Moline, Ill., is making available for commercial use a portable heater which was originally developed for the Armed Forces. This self-contained device is direct fired, and is supplied in two models, one of which uses gasoline as a heater fuel while the other burns No. 2 fuel oil. A small gasoline engine mounted at one end of the unit drives a pressure-type propeller fan which blows air over the combustion chamber and out through the two 12 in. openings at the other end. Air for combustion is supplied by a small centrifugal fan which is driven by the same engine.

Several models are available with various systems of canvas ducts, making the unit suitable for such commercial applications as the pre-heating of airplane engines, or for heating or drying where a portable or temporary source of heat is required.

Micropositioner for Aircraft Service

The Barber-Colman Micropositioner, a recent development of the Barber-Colman Company, Rockford, Ill., is designed primarily for aircraft service. It is a polarized direct current voltage sensitive relay, used for remote positioning of control motors and the control of air valves, engine cowling flaps, trim tabs, and similar aircraft installations.

The contact tongue of the Barber-Colman Micropositioner is positioned by means of a balanced armature. The construction is such that the effect of vibration is reduced to a minimum. The entire operating mechanism is mounted on a bakelite base and enclosed in a transparent lucite case which will afford convenient contact inspection without the removal of the cover. The contact rating is .5 amp. at 28 volts, non-inductive load. Sensitivity is .10 volt, .002 amp.

New Lightweight Contactors for Aircraft Applications

A contactor specifically designed for aircraft applications where small size and light weight are desirable has been announced by the General Electric Company, Schenectady, N. Y. This contactor is especially effective for controlling solenoids and small motors in aircraft.

As designed to conform with the specifications of the United States Army Air Forces, the contactor is furnished in two sizes, 50 amperes and 100 amperes. The 50-amp. type is 2 5/16 by 2 inches in size and weighs 4¾ ounces, and the 100-amp. type is 2¾ by 2⅝ inches and weighs 11 ounces. The unusual light weight of this con-

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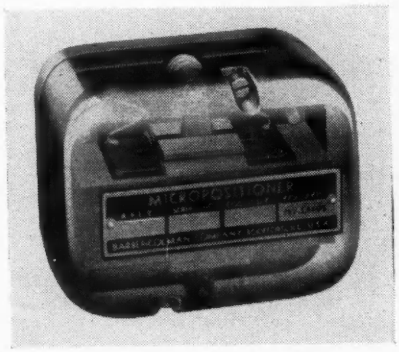
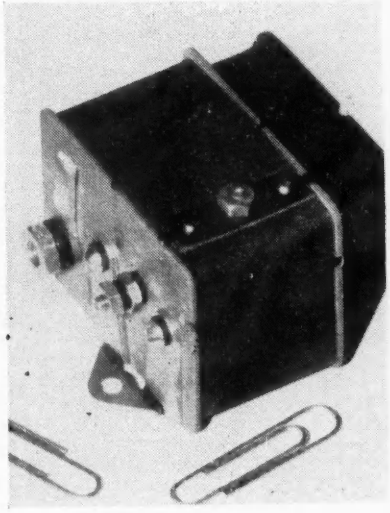
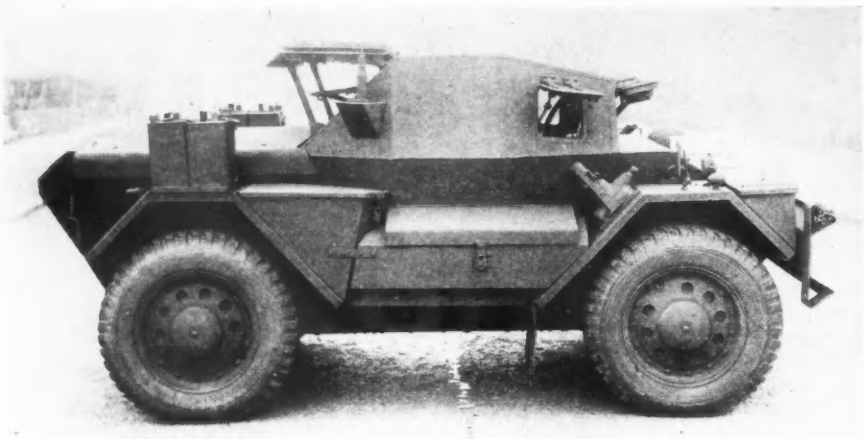


Barber-Colman Micropositioner



G-E 50-Amp. Type Contactor



Right side of the Daimler car with hinged roof and observation ports open.

By M. W. Bourdon
Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

"IN North Africa our patrols were active, penetrating in some cases far behind enemy lines."

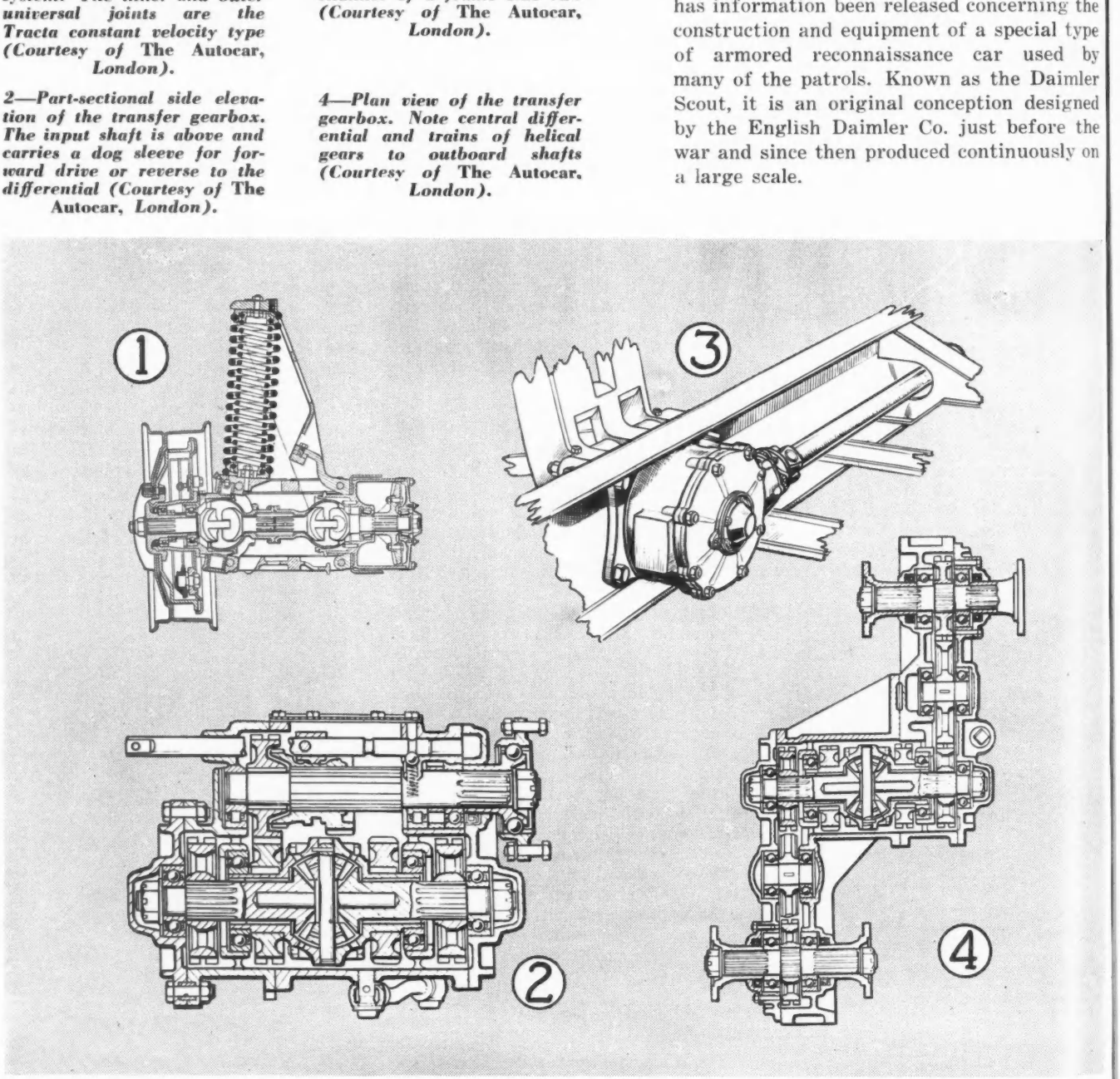
Again and again words to the above effect appeared in reports of the British Eighth Army's desert warfare in the Middle East, but only recently has information been released concerning the construction and equipment of a special type of armored reconnaissance car used by many of the patrols. Known as the Daimler Scout, it is an original conception designed by the English Daimler Co. just before the war and since then produced continuously on a large scale.

1—Section through left front wheel drive and suspension system. The inner and outer universal joints are the Tracta constant velocity type (Courtesy of The Autocar, *London).*

2—Part-sectional side elevation of the transfer gearbox. The input shaft is above and carries a dog sleeve for forward drive or reverse to the differential (Courtesy of The Autocar, *London).*

3—One of the final drive units mounted within the channel of a frame side rail (Courtesy of The Autocar, *London).*

4—Plan view of the transfer gearbox. Note central differential and trains of helical gears to outboard shafts (Courtesy of The Autocar, *London).*



Daimler Armored Car

British Eighth Army Used This Vehicle Effectively for Reconnaissance Work during North African Campaign. Rear engine, fluid flywheel, five forward and five reverse speeds, separate drive to each wheel, and four-wheel independent suspension are its main engineering features.

An illustrated description of this unique vehicle has been published by permission of the Ministry of Supply in *The Autocar* (London), by whose courtesy we are able to give the following summary and some of the accompanying illustrations. The photographs were supplied by the Daimler Co.

The superstructure of the Scout provides protective armor for the two occupants and for all of the mechanism. The underside of the chassis is flat and also completely enclosed, and drivers affirm that it is able to "skate on its belly over deep soft stuff." The armor plating is welded and so disposed as to make it improbable that it will be hit by a projectile at any other than a glancing angle. The car has a low center of gravity and a minimum ground clearance of 10 in.

The six-cylinder engine, which is suspended at three points on rubber, has a piston displacement of 154 cu in. and develops upwards of 70 bhp. Its design is based on a Daimler prewar car engine, the new features including a dry sump and a modified cylinder head with inclined overhead valves that permits an increase of compression ratio from 5½ to 7 to 1. Other modifications include electrical governing, a water-heated intake manifold and a special three-stage type of Solex carburetor, in which the main jet is concentric with the float in order to avoid mixture

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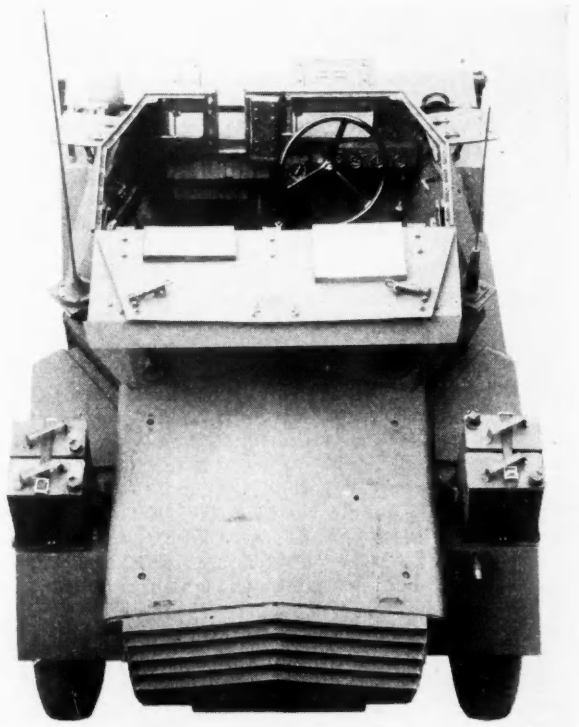
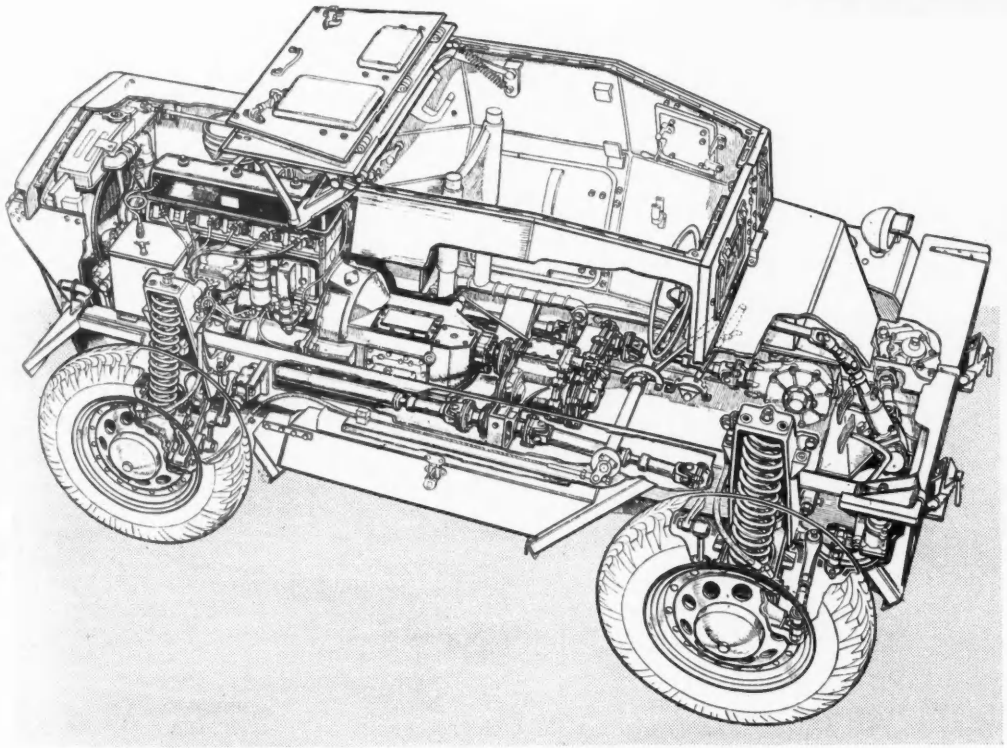


Rear view of the British patrol car from above showing the armor plating above the engine and turret roof folded back.



Cutaway view of the Daimler Scout showing the rear powerplant and the general arrangement of the drive to each wheel, suspension and steering. This copyrighted drawing was made by Max Millar and is reproduced here by courtesy of* The Autocar, *London.

Chevrolet's Setup for Airplane Production

(*Continued from page* 28)

ternal fin sections in the sides of the piston. Unique item of equipment is the Norton piston grinder, fitted with a special formed wheel for finishing three different skirt diameters simultaneously. This machine, too, depends largely upon the functioning of a special diamond wheel truing device for dressing the formed wheel accurately.

The piston ring grooves have tapered walls, the accuracy of the operation being checked 100 per cent on a J & L comparator.

The Fisher Body unit is equipped almost exclusively for the production of gears. It features a large battery of towering Bullard Mult - Au - Matics, Heald rotary and internal grinders, Gleason generators, Bryant internal grinders, Gisholt lathes, etc. There is a sizable screw machine department with Conomatics for pump gears, National Acme-Gridleys for other parts. An outstanding operation is the cutting of a three-jaw dog clutch in one setting on Fellows gear shapers.

The car conditioning building has been equipped with a variety of machines for the production of special nuts of various kinds, including the thrust bearing nut. This department is fitted with Norton and Landis grinders, Bryant and Heald internal grinders, Ex-Cell-O thread grinders, Gisholt turret lathes, 6-spindle National Acme-Gridleys, Heald Bore-Matics, etc. Here, too, is found a battery of the familiar Sunnen hand-honing machines which are used for honing small bores in valve rollers.

Now we shift to the Motor & Axle Plant which is the original Chevrolet-Motor and Axle Division. This plant was completely dismantled and outfitted with new equipment for radial engine manufacture. The only department left intact was the original tool room. Because of the character of this plant, it was assigned the task of producing the larger elements of the Pratt & Whitney engine—the crankcase sections, blower housings, crankshafts, reduction gear housings, cylinder heads, cylinder barrels, propeller shafts, etc.

Some idea of the amount of metal removal involved in this operation may be gained from the following statistics —on the parts made here, they convert to chips, per engine assembly, about 840 lb of steel, 140 lb of aluminum, and 30 lb of magnesium. Incidentally, 30 lb of magnesium make a tremendous pile of chips.

Throughout this Chevrolet operation, painstaking attention has been devoted to the problems of handling magnesium due to the fire hazard that is ever present. Generally speaking, they have developed some important ground rules. For one thing, magnesium is cut at the fastest speed possible on any given machine, using very sharp cutting tools which are maintained with sharp edges at all times. Heavy cuts are employed wherever feasible since fine chips are prone to ignition. As an additional safety factor, they use a cutting fluid of a special type, blended with kerosene to promote cooling.

The motor and axle plant was built only five years ago and designed for the production of 1700 engines and equivalent sets of Front and Rear Axles per day. As equipped for radial engine parts production, the plant boasts large batteries of Bullard V-T-L's, fitted with Carboloy tools, Heald Bore-Matics, Sundstrand Rigidmills, Natco drills, Natco horizontal six-head automatic machines for boring, drilling and tapping on power and blower sections, Cincinnati Bickford radial drills, Ex-Cell-O boring machines, Bryant internal grinders, Monarch lathes, Bullard Mult-Au-Matics, Fay automatics, Heald internal grinders, etc.

Due to the multiplicity of detail operations on the large engine sections, it is not feasible to touch upon the variety of operations involved in the complete sequence on any of the parts. However, here and there it is practicable to comment on some interesting phase of the job. For example, the rear crankcase section embodies an important detail. Here is a case where two dowel pin holes are drilled and reamed in the joint face to serve as the location for all subsequent machining operations. The joint faces of the three crankcase sections are lapped by hand on rotary cast iron plates within 0.005 in. for parallelism. The fastening holes in these sections are reamed, one at a time, on Cincinnati-Bickford radial drills to a tolerance of 0.0005 in.

The center section is fitted, after machining, with pressed in steel liners. The bores of the liners in the front and rear of the section are ground in one setting, for extreme accuracy of alignment, on a Bryant No. 24-36 internal grinder.

Cylinder barrels are received as rough forgings weighing about 52½ lb and are reduced to but 8 lb finished. They are turned on Bullard Mult-Au-Matics, finned on Fay automatic lathes. Barrels are transported on a special Mechanical Handling System monorail conveyor in cradles fitted with wood trays holding three barrels in the upper tray and three in the lower tray. Barrel bores, after grinding, are honed on a battery of Barnes Drill hydraulic honing machines fitted with Micromatic hones.

Cylinder heads are machined on an adjacent line, initial operations being performed on a battery of Bullard Mult-Au-Matics. After the assembly of heads and barrels, the barrels are coated with aluminum in a special metallizing machine. Crankshafts come in at 181 lb in the rough forging, are reduced to 75 lb finished weight, without counterweight. In keeping with aircraft engine practice, all steel parts are inspected for surface quality by Magnaflux inspection.

Distinctive feature of the Chevrolet operation is Aviation Engine Plant 1, the third plant of the group, devoted exclusively to assembly and testing of the engines. Receiving inspection is a major function since all of the materials required in the assembly department come in from the other Chevrolet plants or from outside vendors.

Assembly operations begin with the "green" assembly line, engines being integrated on special dollies which are hooked into the floor conveyor chain. Assembly starts with the blower case, building up the blower section first. Then the fixture is turned over for building up the power section.

Following automotive assembly line practice, this department is so laid out that sub-assembly benches are arranged in parallel rows at right angles to the green line conveyor, feeding in at approximately the point of application.

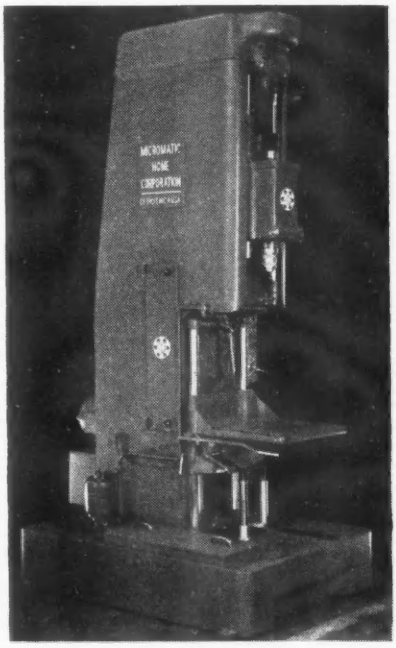
Upon completion of assembly and inspection, the engines are transported to the test cells for the green run. Following the test schedule, engines are torn down completely, the individual parts are washed, then the parts are distributed to a row of inspection benches, certain groups of these handling one type of part such as crankshaft, rods, head and barrel assembly, cases, accessories, etc. Each group of benches, therefore, takes care of a family of similar parts taken from all of the engines torn down for inspection.

Upon passing inspection, the various parts are taken over to the final assembly line which is a counterpart of the green line. Here the parts for each individual engine are identified and segregated for assembly according to serial number. Following this, the engines proceed to test cells for the final acceptance run. When the acceptance run has been completed, the engines are cleaned, and transported to the "preparation" line where they are fitted with various details and made ready for shipment.

Following general practice of the industry, fire protection is afforded by two comprehensive Cardox liquid carbon dioxide systems of 8-ton capacity each. In Aviation Engine Plant 1, the Cardox system protects all of the test cells, galleries, carburetor test rooms, etc. Here each test cell has automatic control with manual standby, applying total flooding in the test cell and in each control room. In addition, the test cell corridors are protected with hose reels connected to the central storage tank.

In the Motor & Axle Plant, fire protection is designed around electrical and inflammable hazards. Automatic protection is supplied for such hazards in the heat treating department for quench tanks, quench presses, etc. For auxiliary protection in this plant as well as in Aviation Engine Plant No. 2 they have adopted the new Cardox Transitanks, portable hose reel trucks.

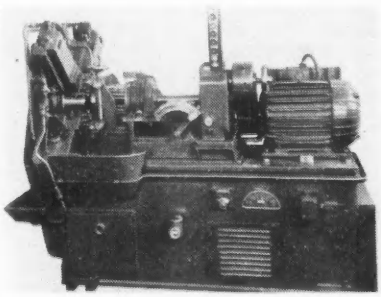
New Production Equipment



Micromatic Honing Machine

THE Snyder Tool & Engineering Co., Detroit, Mich., has designed a multiple spindle hydraulic back spotfacing machine to back spotface, at one time, the entire set of bolt holes in the cylinder barrel flange of certain types of aircraft engines.

The cylinder is loaded in a horizontal position and clamped manually in place on a sliding fixture. Cutting tools run in nitrided steel bushings, and are mounted on hydraulically actuated tool



The Snyder back spotfacing machine

slides which move away from the work to permit loading. After the part is clamped in place, the cutters are brought into correct working position and then the multiple spindle driving head is manually advanced so that the drivers pass through the bolt holes and engage the cutting tools for spotfacing. While the drivers are rotated manually, to reach full engagement with the cutting tools, it is not necessary for the operator to touch the cutters. To eliminate possible tool breakage, a safety device behind each driver prevents starting the machine until all drivers are fully engaged. With the drivers and tools fully engaged, the tools are rotated under power and the cylinder is fed against the cutters. When the full depth of cut has been made, the tools dwell in the work momentarily to assure a smooth machined surface.

A NEW line of vertical honing machines is being offered by Micromatic Hone Corporation, Detroit, Mich.

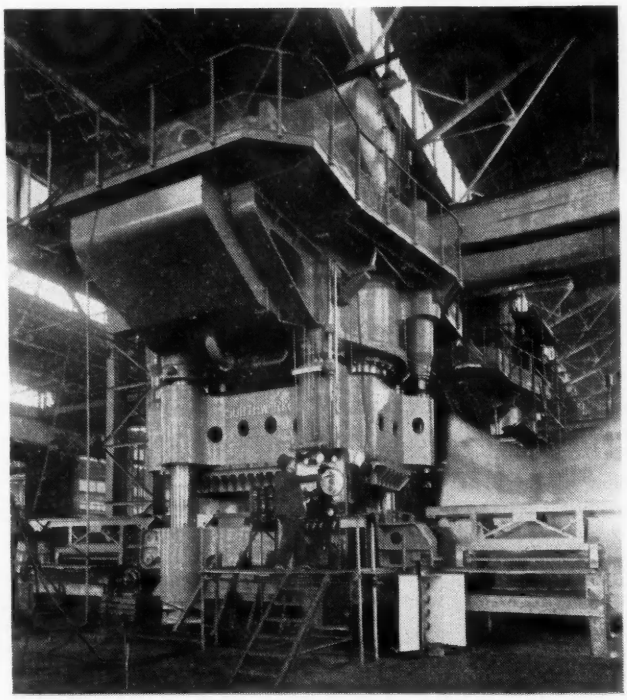
These machines are made in two models. The first has capacity from ¼ in. to ⅞ in. diameter work up to 12 in. long. The second model from ⅞ in. to 2 in. diameter work up to 12 in. long. Both models have a maximum working stroke of 15 in.

The spindle is driven by a spline, which is belt-driven. The spindle is also arranged with integral, mechanically actuated reciprocation of the tool. The entire spindle head is reciprocated on flame hardened and precision honed bars under hydraulic control with adjustable speed. Standard manual adjustment is provided for the spindle head, and also, an adjustment of lift-out stroke above the operating stroke.

Additional hydraulic controls, provided in the hydraulic control panel, include: Automatic timer for cycle of spindle head movement, manual visual control of tool approach to the work, dwell control for spindle head stroke, and emergency stop for spindle head movement. Electric controls comprise all push-button controls for start, stop and short stroke. These machines are regularly furnished with riser block tables, and have ventilated columns.

AN "Angle-Set-Magnet-Block" for magnetic chuck grinding has been brought out by the Diamond Tool Company, Chicago, Ill. This dresser is described as comprising a "Magnet

(*Turn to page 74, please*)



This 5,500-ton capacity Southwark Hydraulic Press is one of three just completed by The Baldwin Locomotive Works, Eddystone, Pa., especially for forming duralumin aircraft parts.

The press is of the rapid-action type, and is completely automatic, having control of pressure, operating speed, and length of stroke. It is also equipped for semi-automatic or manual operation.

The press stands 33 feet high and weighs approximately 960,000 pounds.

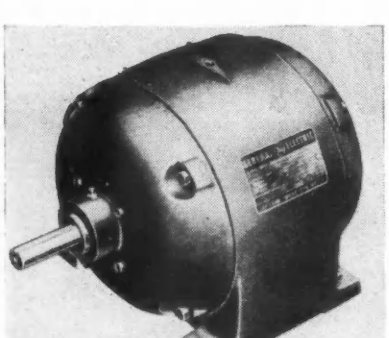
New Products

Totally Enclosed Tri-Clad Motors

A new line of totally enclosed motors has been added to the group of Tri-Clad motors made by the General Electric Company, Schenectady, N. Y. Available in both the polyphase, 60-cycle, induction type and the single-phase, 60-cycle, capacitor type, the new motors are especially designed for use under conditions where abrasives, chemicals, rain, snow, and excessive dirt are encountered.

The polyphase motors are furnished in frame sizes 203 to 225. They include ½, ¾, and 1 hp at 900 rpm; ¾, 1, and 1½ hp at 1200 rpm; 1, 1½, and 2 hp at 1800 rpm; and 1½ and 2 hp at 3600 rpm. The single-phase motors are furnished in frame sizes 203 and 204, and include ¾ hp. at 1200 rpm; 1 and 1½ hp at 1800 rpm; and 1½ and 2 hp at 3600 rpm. The mounting dimensions of these motors are interchangeable with Tri-Clad open motors of the same rating.

All parts of the motor enclosures are cast iron, thus offering resistance



G-E Totally Enclosed Induction Motor

to rust, corrosion, accidental blows, and rough use. The leads are permanently encased in compound in a cast-in pocket in the stator frame, preventing liquids from seeping into the motor. Still further protection is provided in the form of a rotating labyrinth seal, which prevents dirt, oil or water from entering the bearing housing. The motors are wound with Formex wire.

Heat-Resistant Lucite

A new formation of "Lucite," called high heat-resistant "Lucite" methyl methacrylate resin molding powder, has been developed by E. I. du Pont de Nemours & Company, Wilmington, Del. It is said that many articles molded from this special formation will not soften appreciably or distort when exposed to a temperature of 212 deg. F. This is 30 deg. to 40 deg. F above the useful temperatures for similar articles made from other thermoplastic molding powders.

The high heat-resistant formula has approximately the same mechanical, optical, electrical and molding properties as the general-purpose "Lucite" molding powders now used for reflectors on military vehicles, Army compasses, Navy control equipment indicators and other items of ordnance. Articles made from it are crystal-clear, or the powder may be dyed or pigmented to desired colors. General purpose "Lucite" powders will continue in molded articles where high heat-resistance is not required. Both are under allocation for war uses.

Solutions for Chrome Plating Aluminum

The Colonial Alloys Company, Philadelphia, Pa., has developed solutions, for chrome plating aluminum, which are said to make possible plating thicknesses up to .050 in. without hydrogen embrittlement, crazing or lifting. The method consists of a preparatory dip of the aluminum into an alkaline solution, for about one minute at room temperature. The application applies to all forms of aluminum and aluminum alloys, and it is claimed that tests have shown the adhesion of the plate to the aluminum to be at least 16,000 psi.

Electronic Time Interval Meter

A new electronic time-interval meter for accurately measuring extremely short intervals has been announced by the General Electric Company, Schenectady, N. Y. Specifically, the meter is designed for measuring the time interval between two events which can be converted into electrical impulses, such as the elapsed time between the closing of two controls; between two impulses to a phototube; and between an electrical impulse and a light impulse.

Consisting of two units, an electronic panel and a phototube with its preamplifier stage, the meter has eight ranges, selected by means of a tap switch so that any time interval of a length between .0001 second and 3

General Electric Time Interval Meter

seconds can be measured. A standard indicating instrument calibrated in milliseconds gives a direct reading of the time interval measured.

The normal imput signals consist of changes of light intensity falling on the phototube or the making of external electrical contacts. In the former case, light values as low as 1/100 lumen can be used on the phototube.

Operating from a 115-volt, 60-cycle lighting circuit, the meter is stabilized so that normal line-voltage variations do not affect its accuracy, which is two per cent of full scale value, or one scale division. The meter will continue to indicate the time interval after measuring, with a drift of less than one division per minute. When another reading is required, a push button immediately clears the dial.

New Bimetal for Circuit Breakers

Chace No. 6850, a thermostatic bimetal combining high electrical resistance with a high deflection rate, is being introduced by the W. M. Chace Co., Detroit, Mich. Electrical resistivity is given as 850 ohms per circular mil foot, or 668 ohms per square mil foot, at room temperature. Deflection rate is practically uniform between 0 and 400 deg. F; slightly lower above and below those temperatures. Operating characteristics are said to remain constant at temperatures as low as —100 deg. F.

This new bimetal is intended primarily for thermostatic resistors which operate as a result of the heating effect of the current. Its present applications range from flashers to motor overload protection, including particularly the newer circuit breaker designs.

4-Engine Bombers Being Produced About 6 Months Ahead of Schedule

General Motors Corporation Has Become Nation's Largest Producer of Guns for the Armed Forces

General Motors Corp., formerly the nation's largest producer of automobiles, has become the biggest manufacturer of guns for the armed forces. Twenty per cent of the GM divisions, 23 out of 112, in the United States and Canada, are engaged in the output of 15 different types of weapons. In a recent month 118,000 guns were turned out by GM. Through application of automotive techniques, such as overhead conveyors, stamping methods and new rifling processes, the production rate for guns has been stepped up greatly. Seven GM gun plants have received the Army-Navy "E" award.

GM engineers first looked at blueprints for a gun in 1938 when preparations for "M Day" were being made. In May, 1940, two years later, an educational order for 500 machine guns was placed by the War Dept. with Saginaw Steering Gear Division. Then the national defense program got under way and in September, 1940, GM received a $61,398,000 contract for 71,225 Browning .30 and .50-caliber machine guns to be divided among four divisions—AC Spark Plug at Flint, Frigidaire at Dayton, Brown-Lipe-Chapin at Syracuse, and Saginaw Steering Gear. Volume output got under way in the spring of 1941. After two years of machine gun production, AC Spark Plug is turning out the weapons 2½ times faster than the normal time previously required. Through design, manufacturing or material changes, AC engineers have altered 145 out of 270 piece parts in the .50-caliber gun. The cost has been cut by more than half.

Guns which GM is making range in size from the useful Army .30-caliber semi-automatic carbine to 4.7-inch anti-aircraft guns which can bring down enemy aircraft flying over seven miles high. Inland Mfg. Division, Dayton, was the first contractor to get into production on the .30-caliber carbine, which weighs only 5¼ pounds. All but three major parts are subcontracted. Saginaw Steering Gear also makes this gun. Oldsmobile made the conversion from horsepower to firepower two years ago, starting with the manufacture of a Hispano-Suiza 20-mm. aircraft cannon. Now it is the largest private gun plant in the country based on daily output of firepower. It has added two types of 37-mm. aircraft cannon and three weapons for tanks and tank destroyers —75-mm., 76-mm. and 3-inch. Oldsmobile fabricates only 12 out of 769 parts for its guns, subcontracting the other 757.

(*Turn to page* 52, *please*)

Income of Automotive Companies Drops in 1942

In marked contrast with their peacetime showing, net income after taxes of automotive companies fell to 4.5 per cent of sales in 1942, the year of complete conversion to war production, according to an analysis of the 1942 annual reports which have been made available.

In the preceding year, net income was 6.7 per cent and in 1940 it reached 8.3 per cent of net sales, a survey by the Automotive Council for War Production of 36 automotive vehicles and parts manufacturers shows.

While the 1942 percentage net profits on sales was cut nearly half from that of 1940, last year's showing may still be subject to further downward readjustments, due to possible contract renegotiations, George Romney, managing director of the Automotive Council, pointed out.

He explained that through efficient production methods the automotive industry had been able to effect savings running into hundreds of millions of dollars, which have been passed back to the government.

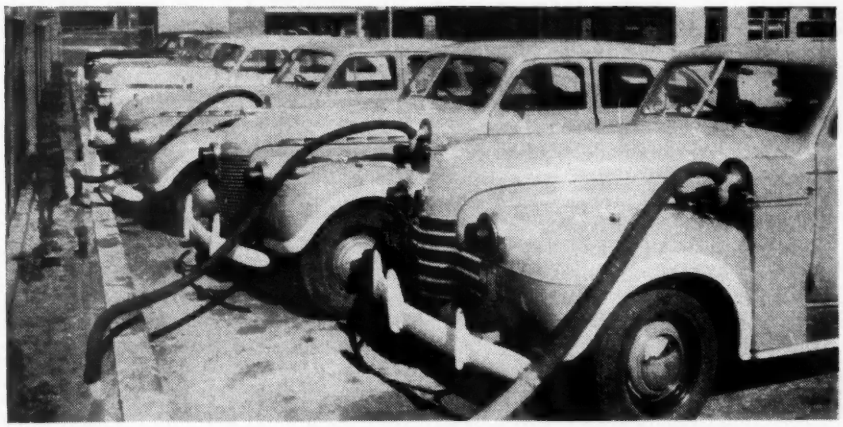
NAM Finds Wartime Absenteeism Up 56%

The National Association of Manufacturers announced that as a result of an absenteeism survey in 25 of its member company war plants it had been established that the wartime average of absenteeism in those companies has increased 56 per cent since the war effort started.

The present, or wartime, percentage of absenteeism was found to be 5.42 per cent of workers as compared to 3.48 per cent before the war, the survey showed.

The association, which conducted the survey through its industrial relations department, listed as chief causes of absenteeism sickness, accidents, housing and transportation problems, high earnings, inexperience in regular employment and irresponsibility.

It found also that in industries with a high rate of absenteeism the lost time is greatest on Saturdays and Mondays.



Starting Cars Under Difficulties in Australia

Company cars of General Motors-Holdens fitted with the G.M. Nasco Gas Producer are started without the use of gasoline by a common suction unit. The lead-off hoses attached to a sunken pipe-line are coupled to the cleaner exit of the producer. Three cars may be started at once in an average of four minutes, as this time is required to fan up the fire to a point where a combustible mixture is available at the mixing valve, and the car can be run on charcoal gas.

April Production of Electric Furnace Steel Sets New Record

Output of Steel Plates in First Three Months of 1943 More Than Twice What It Was in First Quarter of 1941

By W. C. Hirsch

The blackout of statistical information, on which the metal markets lean heavily for guidance, is giving way to a dimout that promises to confine itself more so than has recently been the case to the withholding of only such information that would directly be of benefit to the enemy. The American Iron & Steel Institute has resumed its publication of month-by-month production reports. Figures of 1942 copper, zinc, and lead production have also come recently from the U. S. Bureau of Mines, and while 1942 seems a long time ago and these figures are perhaps of little practical value to-day, there has always been a gap of several months between the end of a year and their compilation and publication. The important point in all this is that jitters over the possible divulging of a military secret, which for a time banned all statistical tabulations, have now yielded to selective segregation of what it would be unwise to publicize without withholding information of no value to the enemy, but of the greatest importance to American industry.

American Iron & Steel Institute figures for the first three months of the current year reflect, of course, the progress of the war. Output of steel plates was more than twice what it was in the first quarter of 1941, sheet and strip production having been sharply reduced. This only bears out what every one knew, that more and more steel was needed for shipbuilding and that suspension of automobile manufacture resulted in the diversion of much rolling mill capacity to the production of steel plates in place of sheets. Topping in interest statistical confirmation of what, after all, is an old story, are the Institute's latest figures on the production of electric furnace steel, demand for which from aircraft manufacturers and for tank armor is still on the uptrend. April production set a new high record of nearly four hundred thousand tons. At the annual meeting of a company, that specializes in the production of electric steel, it was brought out that construction of additional furnaces now under way will give it in a few months an annual capacity of 1,715,000 tons. Five years ago—on Jan. 1, 1938—the Institute's Committee on Survey of Capacity, rated the entire industry's potential output of electric steel at 1,331,124 tons a year. The 1943 electric steel output promises to be in the neighborhood of five million tons.

WPB will terminate on June 30 the previously established schedule of prices paid for idle aluminum and will direct such material into normal scrap channels. This applies to non-usable aluminum reported after June 30 by holders of idle inventories.

In connection with the visit to the United States of President Penaranda of Bolivia, it is pointed out that Bolivian tin producers are dissatisfied with the price they are getting for tin concentrates purchased from them by the U. S. Government's Metals Reserve Company. They are now receiving 60 cents per pound, f.o.b. South American port, and are reported to be asking 70 cents when the contract is renegotiated. The time for this is before June 30, when the present arrangement permits it. The present maximum price for tin in the United States is 52 cents.

To a delegation of the cadmium industry the War Production Board stated that the use of cadmium was steadily increasing. A program aiming at reduction of stocks in consumers' hands from eight months' to three months' supply caused a slowing down in buying. This, however, was merely temporary and is expected to be made up for by an early resumption of ordering.

NMTA Convention and Production Conference

Major figures in the war effort, including Maj.-Gen. Lewis B. Hershey, director of Selective Service, and Dr. William Haber, director of planning, War Manpower Commission, were featured speakers at the 45th annual convention and production conference of the National Metal Trades Association held in the Palmer House, Chicago, May 26-27.

Among others who addressed the convention, were C. Scott Fletcher, director of field development, Committee for Economic Development; William A. Patterson, president of United Airlines, and John H. Van Deventer, president and editor of *The Iron Age*. Mr. Fletcher and Mr. Van Deventer discussed phases of industrial post-war planning.

Sessions were opened by Roe S. Clark, of Springfield, Mass., association president, who offered a report on N.M.T.A.'s activities for the past year, including job and salary rating, apprentice and foreman training, and wage surveys. Due to exigencies of the war situation, Gen. Hershey's talk was "off the record." Dr. Haber spoke on "Manpower and Total War." Mr. Fletcher's topic was "Industry's Part in Winning the Peace," Mr. Patterson's "Airlines in the War Effort," and Mr. Van Deventer's "The Post-War Outlook for Metal Industries." Other subjects ranged from Mr. Bellaire's "Crush Japan Now" to management-labor relations, small businesses' place in the war effort, production incentives, and wage and salary stabilization.

Continental Appoints Branch Manager

Henry A. Nichols has been appointed manager of the branch office and warehouse of the Continental Rubber Works at Memphis, Tenn. Mr. Nichols has been long associated with the marketing of mechanical and automotive rubber products, and more recently has been servicing these products.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

Broadening fluctuations of general business activity have indicated a current level close to the peak recorded at the end of February. The seasonally adjusted index of *The New York Times* for the week ended May 8 was 140.0 per cent of the estimated normal, as compared with 135.7 for the preceding week and 132.6 a year ago.

Department store sales during the week ended May 8, as reported by the Federal Reserve Board, were 12 per cent above the corresponding level in 1942. For the period of four weeks then ended, the total was 13 per cent greater than a year ago; and for 1943 to date sales have registered a comparable increase of 11 per cent.

Railway freight loadings during the week ended May 8 totaled 816,551 cars, 3.5 per cent more than in the preceding week but 2.7 per cent below the number a year earlier.

Electric power output during the same period rose contrary to the usual seasonal trend and was 16.0 per cent greater than a year ago, as against a similar excess of 17.0 per cent in the week before.

Crude oil production in the week ended May 8 averaged 4,020,500 barrels daily, 101,350 barrels above the figure for the preceding week and 476,150 barrels greater than the output a year ago.

Average daily production of bituminous coal in the same period was 1,700,000 tons, as compared with 1,583,000 tons for the week before and 1,894,000 tons a year ago.

Engineering construction contracts awarded during the week ended May 13, amounting to $91,019,000, were 60 per cent below the corresponding total in 1942, according to *Engineering News-Record*. For the current year to date a similar decline of 59 per cent is shown.

Professor Fisher's index of wholesale commodity prices for the week ended May 14 was again unchanged at 111.8 per cent of the 1926 average, as against 111.9 three and four weeks earlier.

Member bank reserves decreased $104,000,000 during the week ended May 12, and estimated excess reserves dropped $400,000,000 to a total of $1,730,000,000. Business loans of reporting members declined $42,000,000 in the same period and stood $1,104,000,000 below the total a year earlier.

"ARMOR PLATE IS APPLE PIE FOR THE POR-OS-WAY WHEEL"

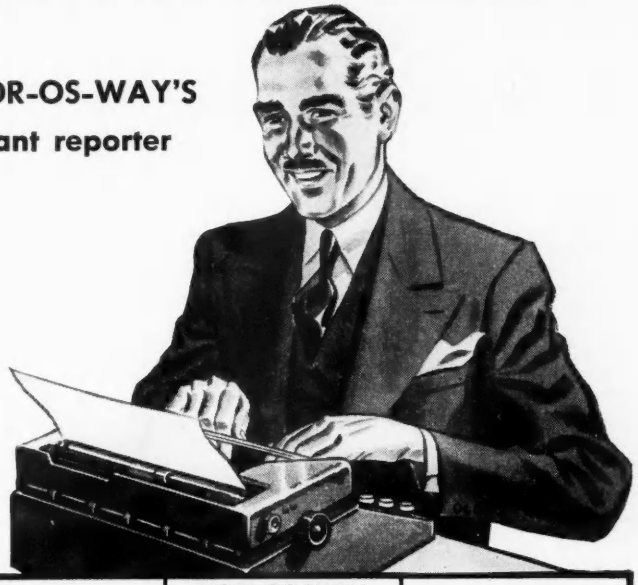
Dear Charlie:

Here I am at the plant. You told me to get the story on Por-os-way. Here it is – and it's a honey. Grinding the edges of armor plate is a tough assignment for any wheel. And these edges are case hardened because they're torch-flame cut. You can see for yourself armor plate is apple pie for the Por-os-way wheel. Por-os-way is way out in front of the previous wheel used.

Your roving reporter

"Vic"

writes POR-OS-WAY'S War Plant reporter



THE RESULTS	POR-OS-WAY WHEEL	FORMER WHEEL
Number of pieces per hour, 4 sides per piece including setting up time	5	2
Wheel dressing required	None	Every 6 or 7 pieces
Life of Wheel	4.5 days (108 hrs.)	½ day (12 hours)
Average depth of cut per pass	.008" to .125"	.006"maximum
Speed of removal for 30" of edge	2 minutes	20 minutes
Number of passes required	7	15
Time per pass	2½ seconds	4 seconds (wheel chipped at faster speeds)
Number of man-machine hours per month, 3 men on 3 machines; 8 hours, 3 shifts, 30 days per month	2160	
Number of pieces finished (4 sides) per month—including setting up time	10800*	4320
Monthly increase in production through use of Por-os-way Wheel	**6480** pieces	2½ times **more** than previously

THE JOB:

Removing average of 1/4" stock from all four edges of 1/2" and 3/4" armor plates, consisting of mild steel one side, hardened steel (600 Brinnell, 35-37 Rockwell) on the other. Torch cutting case hardens the edges. Three Rogers grinders used.

THE WHEEL:

Por-os-way segments — 4 1/8" x 1 1/4" x 4" A24KV2.

All facts and figures given are taken from an actual field survey made by a Por-os-way correspondent.

WRITE *for complete booklet "Facts About Por-os-way". The address is 466 Wheatland St., Phoenixville, Penna.*

*Por-os-way actually removed stock 10 times faster than previous wheel but inclusion of setting up time, being a proportionately large factor, reduces ratio to 5 to 2.

2 TO 5 TIMES MORE WAR PRODUCTION PER MAN PER MACHINE

POR-OS-WAY* *a new* RADIAC* PRODUCT

A. P. DE SANNO & SON, INC.
NEW YORK, CHICAGO, PITTSBURGH, CLEVELAND, DETROIT, LOS ANGELES

PHOENIXVILLE, PENNA.
Western Gateway to VALLEY FORGE

*T. M. Reg. U. S. Pat. Off.

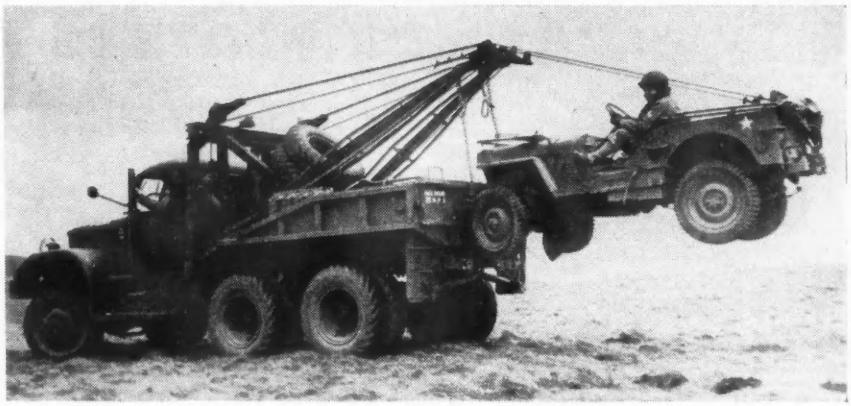
AAC Holds Meeting, Elects Officers

In the opinion of leading parts and equipment manufacturers who are members of the Automotive Advertisers Council, mortality among automobile dealer establishments and repair shops, due to the war, has just about spent itself. From this point on, it is expected that the rate of mortality will be no greater than in peace time, and the future of established service shops is viewed with much greater optimism than it was six months ago. The Council's viewpoint on the strength of the industry's wholesale distributing organization is even more encouraging. Jobbers are credited with an outstanding service to all branches of the trade in the maintenance of essential wartime transporation. In the opinion of the council, they are assured a more important place in the economy of America in post-war years than ever before.

The Automotive Advertisers Council is composed of executives in charge of advertising and sales promotion for leading manufacturers of parts, supplies and equipment for the automotive after-markets. At the annual meeting in Pittsburgh, Pa., May 13 and 14, 1943, representatives from nine states were in attendance. Jack Wiggins of the Washington office of N.S.P.A. and Bill Boney of M.E.W.A. also attended. The two-day sessions were devoted to round-table discussions on the subjects of post-war planning, relations with business paper publishers, trends in advertising and selling, and election of officers.

The following were elected by the membership to serve a two-year term on the Board of Governors; J. F.Apsey, Jr. (Black & Decker), R. W. Case, Jr. (Thermoid Co.), W. A. Kirkpatrick (Wilkening Mfg. Co.), and R. M. Schutz (Maremont). An executive Committee was created, by vote of the membership, to consist of the officers and the retiring president. Election of officers for the 1943-44 term by the Board of Governors resulted in the following: President—R. W. Case, Jr. (Thermoid), Vice-president—T. Faxon Hall (Walker Mfg. Co.), Secretary-Treasurer—Carl B. Dietrich (Wagner Electric). These new officers and Chas. Tapscott (McQuay-Norris), the retiring president, constitute the new Executive Committee.

Chairmen of Committees, as appointed by the new president, are: Advertising Distribution Practices—H. E. Robinson (Fram), Catalogs—C. B. Dietrich (Wagner Electric), Publicity—W. A. Kirkpatrick (Wilkening), Trade Paper Relations—T. Faxon Hall (Walker), Trade Shows—J. F. Apsey, Jr. (Black & Decker).



Transporting Mechanized Casualties

U. S. Army Ordnance Battalion repairing mechanized equipment under battlefield conditions somewhere in England. The Jeep is suspended from the back of a 4-ton wrecker. British Combine photo.

Annual Report of the Automotive Parts and Equipment Manufacturers, Inc.

War production by the automotive parts industry increased more than 15-fold in the year between June 30, 1941 and June 30, 1942, according to the annual report of the Automotive Parts & Equipment Manufacturers, Inc., announced by Frank Rising, general manager. In the year ending June 30, 1941, 302 plants belonging to the APEM reported sales volume of aviation parts and other defense work totaling $54,868,091, which was 4.3 per cent of these companies' total sales. For the year ending June 30, 1942, including 6½ months when the U. S. was at war, the sales volume of aviation parts and war products by 301 APEM member plants had jumped to $882,313,401, an increase of 1531 per cent. This latter total was 51.5 per cent of 1941-42 total sales volume by the member companies.

Total sales volume of the APEM members reporting advanced from $1,267,733,385 in the 1940-41 period ending June 30, 1941 to $1,712,563,436 for the 1941-42 period ending June 30, 1942. This marked an increase of 35 per cent. Original equipment sales declined 42 per cent from $1,004,984,314 in 1940-41 to $585,859,339 in 1941-42, civilian automobile production having ceased in January, 1942. Original equipment comprised 79.3 per cent of 1940-41 sales volume but was only 34.2 per cent of 1941-42 sales.

Sales of replacement parts and accessories advanced 17 per cent from $190,373,031 in 1940-41 to $222,857,265 in 1941-42, emphasizing the greater need for spare parts to keep cars running after the cessation of new car production. Replacement parts and accessories comprised 15 per cent of 1940-41 total sales compared with 13 per cent of 1941-42 sales. Sales of automotive shop equipment and service tools increased 45 per cent from $7,139,059 in 1940-41 to $10,313,803 in 1941-42.

Sixty-nine large makers of automotive original equipment had 1941-42 sales volume of $998,945,179. This was 27.2 per cent greater than the previous year and marked an increase of 108 per cent over 1936-37 sales volume of $478,803,372. The latter was the largest volume for any year prior to the inauguration of the national defense program in June, 1940. The 1941-42 sales also were 289 per cent greater than those for 1933-34, in the depths of the depression.

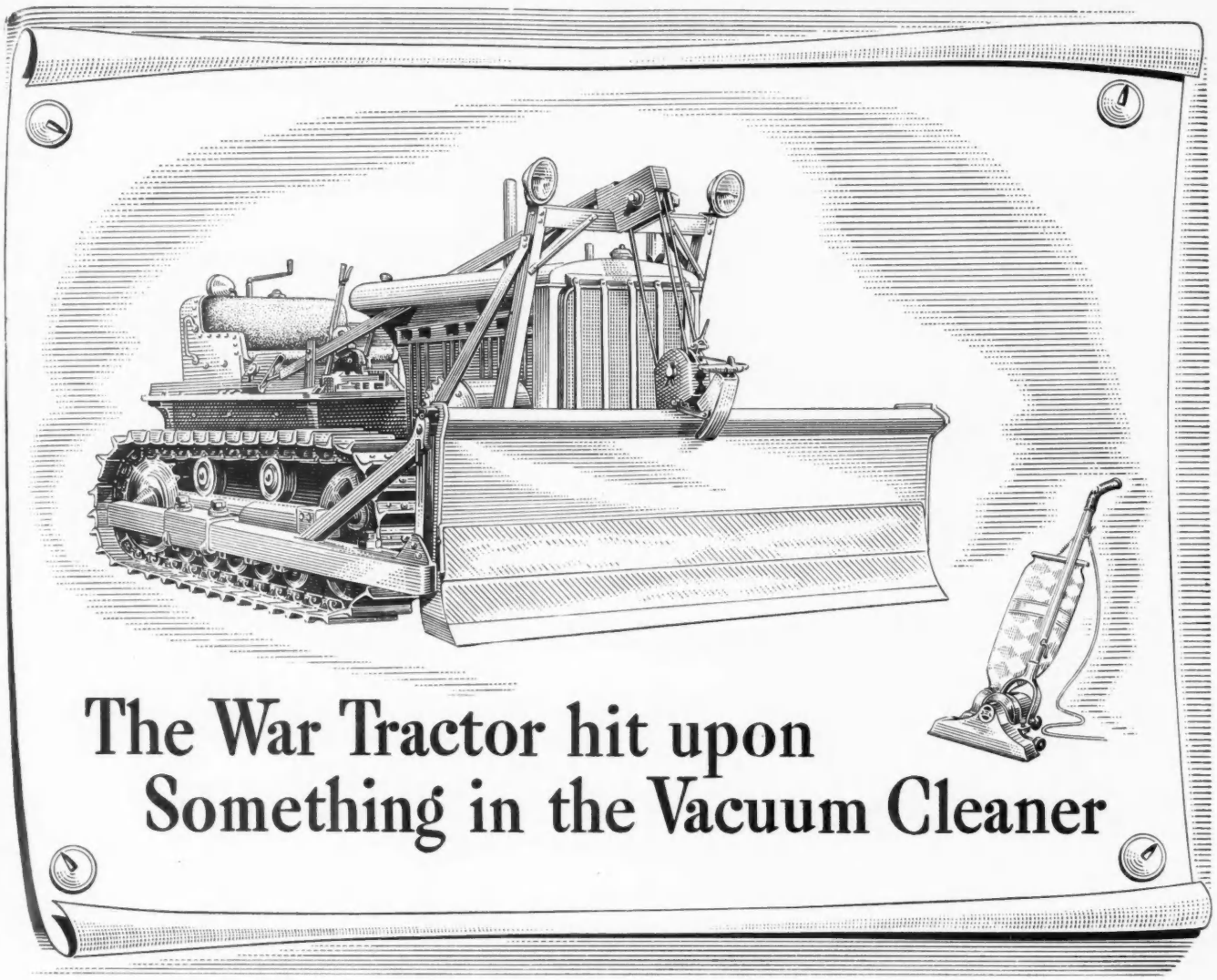
A comparison of sales volume of the reporting APEM members for the year ending June 30, 1941 and the year ending June 30, 1942, is shown in the following table:

	1940-41 Sales	Per Cent of Total	1941-42 Sales	Per Cent of Total
Original equipment	$1,004,984,314	79.3	$585,859,339	34.2
Replacement parts and accessories	190,373,031	15	222,857,265	13
Automotive shop equipment and service tools	7,139,059	.6	10,313,803	.6
Outboard and marine engines and parts	10,568,890	.8	11,219,528	.7
Aviation parts	52,906,660	4.1	256,211,823	15
War products	1,961,431	.2	626,101,578	36.5
Total	$1,267,733,385	100	$1,712,563,436	

New Colonial Plant

Completion of Colonial Broach Company's new plant on Hoover Road, Detroit, has been announced by Carl Halborg, president of the company.

The plant more than quadruples productive floor space as against Colonial's pre-war facilities available for broaches and broaching machines. Of particular interest in the new Colonial plant is the extensive heat-treat department said to be the most complete installation of its kind in the broach industry.



The War Tractor hit upon Something in the Vacuum Cleaner

ON THE FACE OF IT, a vacuum cleaner and a military tractor live in different worlds. The cleaner's job is a light-duty one—and what matters most is easy operation. That's why Torrington Needle Bearings were chosen for use in this household machine. With its low friction coefficient and compact design, the Needle Bearing is one of the reasons modern vacuum cleaners can be as easy to handle as a new broom.

The men who drive the tractors, on the other hand, are concerned chiefly with their ability to stand up under the most severe service conditions. But when a new bomber runway is wanted by dawn, or shell holes must be repaired while bombs are still falling, it helps to have a tractor whose mechanism responds quickly and smoothly. So tractor designers, too, turned to the Needle Bearing for long life and ease of operation... and found many other advantages as well. It seldom needs attention, thanks to an effective system of lubrication... it withstands overloading more easily, because of high load capacity... and it speeds tractor production, through its ease of installation and ready availability for essential applications.

SOMETHING TO KEEP IN MIND FOR POST-WAR. You'll soon be planning your post-war designs—or perhaps you've already started. There may be an idea for you in the Torrington Needle Bearing. Its advantages are the very features Tomorrow's customers are being educated to want—longer life, faster speeds, greater ease of operation, more compact designs, less need of attention. Whatever your design problems, let Torrington engineers help you. They are expert in adapting the Needle Bearing to specific applications. A long list of *typical* uses is included in Catalog No. 107.

NEEDLE BEARINGS FOR ALL PURPOSES

LOOSE ROLLERS are produced in a range of sizes for assembly into low-cost, high-capacity anti-friction bearing units. They are particularly adaptable to applications where volume permits installation of the necessary equipment.

NEEDLE BEARINGS are complete, self-contained units consisting of a full complement of rollers and a thin, hardened outer race. They offer the advantages of small size, low cost, high capacity—and are easily, quickly installed.

QUILL BEARINGS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Quill Bearings are adaptable to heavier load requirements than Needle Bearings.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Connecticut, U. S. A

Makers of Needle Bearings and Needle Bearing Rollers

New York	Boston	Philadelphia
Detroit	Cleveland	Seattle
South Bend	San Francisco	Chicago
Los Angeles	Toronto	London, England

LET'S GO! U.S.A. KEEP 'EM FLYING

TORRINGTON NEEDLE BEARINGS

PUBLICATIONS

Magnus Chemical Co., Inc., has issued a **Metal Cleaning Handbook** described as a technical manual on materials, methods and machines for war time metal cleaning. It is illustrated with charts, drawings and photographs and discusses in logical sequence the factors governing the selection of materials and methods for metal cleaning, followed by a similar discussion of the factors governing the choice of metal washing machines.*

South Bend Lathe Works has issued Catalog No. 14-C giving full information on its 14½ inch **Precision Lathes,** its attachments, accessories and tools. Catalog No. 100-C describes the entire line of South Bend **engine lathes, toolroom lathes and turret lathes.** Each size and type of lathe is illustrated and described, and specifications are tabulated to facilitate the selection of lathe required for any desired application.*

The Barnesdril Honing Process is the title of a new brochure on honing issued by the Barnes Drill Co. It describes the principle of the honing process, and applications of hydraulic honing machines of vertical and horizontal types for finishing cylindrical bores and exterior surfaces of piston rods and shafts. Examples of work as well as equipment are illustrated. It is Bulletin No. 121-H.*

New Departure Division of General Motors Corp. has issued in folder form, miniature reproductions of weekly war production posters used in New Departure plants. Original posters are 24 by 36 inches, printed in two colors. The folder listing these posters is titled **Inspiration for the Folks Back Home.***

Two new planetary milling catalogs have been issued by the Plan-O-Mill Corp. (1) describing the Number 3 **Plan-O-Mill for cylindrical parts** up to 8 inch work diameter; (2) describing the Number 5 for larger parts. The principle of Planetary milling is fully explained and illustrated, together with actual case histories of Plan-O-Mill form and thread milling in war production. Please use your company letterhead is requesting copies.*

The Dayton Rogers Mfg. Co. has issued **a die cushion cutout model** showing the details of pneumatic die cushion equipment as applied to the average punch press. Please use your company letterhead when asking for a copy of this model.*

The Norton Company has issued an attractive six-page color folder describing and illustrating types of jobs using the Norton open structure grinding wheels.*

A 20-page booklet, **Cutting Fluids,** has been issued by Tide Water Associated Oil Co., for the metal working industry. Sections are devoted to types of cutting operations, functions of cutting fluids, selection and application of cutting oils, soluble oil emulsions. Cutting tools are illustrated with photographs and drawings, and various **Tycol** cutting oils and recommendations of their use are also described.*

Mid-West Spring Mfg. Co. has issued a new manual giving formulas of **spring design and engineering** for compression, extension, torsion, flat spiral or motor, flat spring, wire forms, etc. It is complete with illustrations, diagrams and tables.*

A new annotated **Bibliography of Indium** for 1941-42 has been prepared for distribution by The Indium Corp. of America. Copies may be had by addressing the company at 60 East 42nd Street, New York City.*

A bulletin, descriptive of its hard-facing material **No-Wear,** has been issued by the Callite Tungsten Corp. Designated as Bulletin No. 153, it describes the advantages and physical characteristics of No-Wear, methods of applications and typical uses.*

Battelle Memorial Institute, Columbus, Ohio, has published a new catalog listing one-hundred and forty Battelle-originated books, patents and journal contributions. It covers Battelle publications and patents for the years 1941-1942 and supplements a previous listing of over 500 publications and patents of prior date, which listing was published in 1941.

*Obtainable through Editorial Dept., Automotive and Aviation Industries, Chestnut and 56th Sts., Philadelphia. In requesting any of these publications, please give date of issue, your company connection, and position.

ARMY E NAVY

Awards

Names of winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the May 15 issue of *Automotive and Aviation Industries* went to press.

BORG-WARNER CORPORATION, Rockford Drilling Machine Division (three plants).

ARTHUR A. CRAFTS COMPANY, Boston, Mass.

E. I. du PONT de NEMOURS & COMPANY, (two plants).

GENERAL MOTORS CORPORATION, Fisher Body Division, (two plants).

GENERAL MOTORS CORPORATION, Research Laboratories Division, Detroit, Mich.

MINNEAPOLIS-MOLINE POWER IMPLEMENT COMPANY, Minneapolis, Minn.

D. W. ONAN AND SONS, (four plants).

UNITED STATES RUBBER COMPANY, Shelbyville Mills, Shelbyville, Tenn.

BOOKS . . .

TOOL STEEL SIMPLIFIED—*by Frank R. Palmer, Vice-Pres., Carpenter Steel Co. Published by Carpenter Steel Co., Reading, Pa. Price $1.00.*

This book, now in its 11th printing, comprises 315 pages of practically useful information on tool steels and how to get faster tooling and improved tool performance. It is made up of five parts, the first of which includes a glossary of common terms of tool makers and a brief review of steel making equipment and processes. It also covers the analysis of tool steel, the effects of internal defects and a method of insuring against them, what timbre is and how to test for it. The second part is devoted to ways and means of selecting the right tool steel for each kind of tool. Part Three covers the proper heat treatment and testing of tool steels. In Part Four there are discussed such matters as the relation of design to heat treatment, the hot acid etch test, the timbre test, spark testing, furnace atmosphere, quenching and trouble shooting. Part Five is devoted exclusively to useful tables.

Throughout the book diagrams, photographs, charts and tables are used to illustrate clearly important points. It is a book for the man who designs or makes tools and an elaborated explanation of how to make tools last longer.

American Brake Shoe Company

At the 42nd Annual Stockholders' Meeting of The American Brake Shoe & Foundry Company, New York, N. Y., the company name was shortened to American Brake Shoe Company.

MEN . . . . . .

James M. Roche has been appointed to the newly created post of director of personnel for the Cadillac Motor Car Division of General Motors.

SKF Industries, Inc., has announced the appointment of **Robert R. Zisette** as general sales manager.

Elden R. Carl has been appointed director of industrial relations of Adel Precision Products Corp. He was formerly assistant director of Industrial relations of North American Aviation, Inc.

E. A. Swanstrom, formerly president of Elastic Stop Nut Corp. of America has been elected president and general manager of the newly-formed Penn Engineering and Manufacturing Corp., Doylestown, Pa.

D. M. Walsh has been named general sales manager, tire division, United States Rubber Co.

Harry Agerter has been appointed manager of Aircraft Components, Inc. He will be in charge of the company's Van Nuys and Wichita plants.

Universal Gear Corp. has announced the election of two new officers at a recent meeting of its Board of Directors, namely, **Charles H. Amy,** Treasurer and **J. Y. Dahlstrand,** Vice-President.

John E. Wells, formerly of Manning, Maxwell & More, Inc., has been appointed advertising manager of The Aviation Corp.

J. Charles Galbreath has been elected vice-president of Plomb Tool Co. He will retain general supervision of the company's contract dept.

A. W. Scott has been elected president and secretary of Wolf's Head Oil Refining Co., Inc. He was previously vice-president.

Frank E. McGary, engineering and mechanical division chief, has been appointed manager of the Murray Corp.'s Scranton, Penna. plant now under construction. **O. F. Graebner,** chief engineer, has been promoted to the position vacated by Mr. McGary at the Main Division of the Murray plant in Detroit.

Robert Insley, formerly vice-president in charge of engineering at Menasco Mfg. Co., has been named vice-president and executive engineer of Continental Motors Corp. He was with Continental previously in 1928 and helped organize the company's aircraft division.

Col. Edward M. Robbins, formerly chief of the engineering shop laboratory, has been appointed commanding officer of Wright Field, Dayton, Ohio. He succeeds **Col. R. O. Brownfield,** who has been transferred to an undisclosed base.

H. C. Emberson, purchasing agent, has been elected a member of the board of directors of Diamond T Motor Car Co., filling the vacancy caused by the retirement of Edgar J. Uihlein.

Ralph A. Richardson, head of the technical data dept., Research Laboratories Division, of General Motors Corp., has been commissioned a lieutenant in the U. S. Navy and has reported for duty at Fort Schuyler, N. Y.

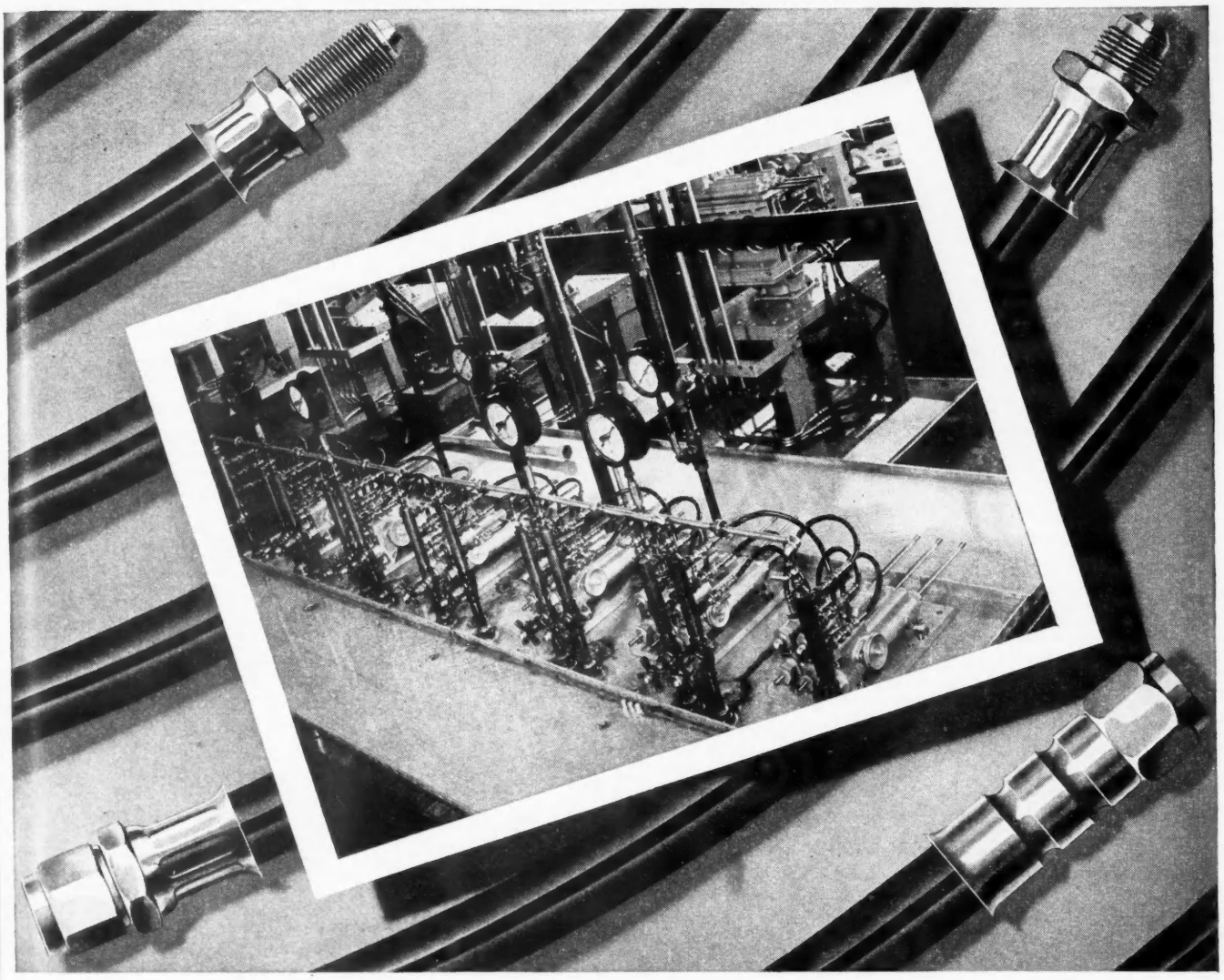
William R. Waddell, formerly sales manager, has been elevated to manager of the service division of Federal-Mogul Corp. **Don Switzer,** formerly assistant sales manager of the service division, has been named sales manager.

Leigh Willard, president of the Interlake Iron Corp., Chicago, nas been elected to the board of directors of Allis-Chalmers Mfg. Co., filling the vacancy caused by the death of **Max W. Babb.**

Irving Taylor has resigned as general manager of the Aeronautical Chamber of Commerce to become associated with Douglas Aircraft Co., Inc., at Santa Monica, Cal.

D. L. Gibb, associated with Dow Chemical Co. for the last 20 years, has been named manager of the plastic sales division. **W. L. Goggin** has been placed in charge of the newly formed plastic development and service division.

Fred O. Burkholder, formerly vice-presi-



5 years of abuse... no signs of wear

AT SPERRY GYROSCOPE COMPANY

Hose lines on a run-in bench for hydraulic equipment take real punishment.

The Resistoflex low pressure hose, shown, carry *hammering pressures of between 150 and 200 pounds 12 times every minute.* Oil flow varies between 1.8 and 3 gallons per minute. Oil temperature varies from room temperature to 135° F. Most of the lines are bent on a 5 inch radius . . . being coupled and uncoupled constantly, manhandled, splashed with hydraulic fluid. Imagine five years of use under these conditions . . . yet showing no signs of breakage or deterioration.

Resistoflex hose assemblies are in use in hundreds of interesting applications such as this. Technical data acquired through many of these may help you solve some of your flexible hose problems.

Write us about them today, or . . .

SEND FOR CATALOG

Write for the Resistoflex Industrial Catalog. On company stationery, please.

RESISTOFLEX FEATURES:

SPECIFICATIONS—Complies with applicable Army and Navy specifications.

STRONGER AND LIGHTER—Outpoints all similar lines in strength and resistance to aromatic fuels combined with light weight—no tendency to whip.

PERMANENT, FULL FLOW—Chemically inert, glass-smooth inner surface provides permanent free flow—eliminates turbulence and skin friction.

NON-CLOGGING—Does not slough-off, nothing to clog hydraulic or lubrication systems, diesel injector nozzles, carbureter jets or other fine orifices.

FLEXIBLE, VIBRATION PROOF—Tens of thousands of simultaneous flexings and twistings have no effect on Resistoflex hose assemblies.

HOSE AND HOSE ASSEMBLIES FOR FUELS, LUBE OILS, VACUUM—GREASE, PAINTS, LACQUERS, THINNERS—DIPPED AND MOLDED GOODS—COATING COMPOSITIONS, GLOVES AND PROTECTIVE GARMENTS.

RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE, NEW JERSEY

dent and sales manager, has been elected president of Ahlberg Bearing Co., succeeding the late C. J. Bender. **C. W. Pearsall,** manager of the automotive division, has been elected vice-president.

A. C. Berg, assistant manager, has been appointed manager of the road machinery division of Gar Wood Industries, Inc. **R. S. Headley** has been named assistant manger of the division.

B. C. Heacock has resigned as director of the Distribution Bureau of WPB to return to his position as chairman of the executive committee of Caterpillar Tractor Co.

Dr. Frank K. Schoenfeld, who has specialized in the development and application of Koroseal, has been appointed technical superintendent of the chemical division of B. F. Goodrich Co.

Clyde Vandeburg has resigned as deputy director of OWI and chairman of the Government's inter-agency production information division to become general manager of the Aircraft War Production Council, East Coast, Inc., with offices in New York City. Vandeburg was assistant to the president in charge of industrial relations for Packard Motor Car Co. until January, 1941, when he went with the Government.

Young Radiator Company announces the appointment of **A. R. Johnson,** who will maintain offices in Long Beach and Los Angeles, California, as Sales and Engineering Representative in the California territory south of and including Inyo, Kern and San Louis Obispo counties and Clark county in Nevada.

Joseph H. McDuffee

Joseph H. McDuffee, 64, vice-president of Electric Auto-Lite Co., died May 12 at Toledo. He had been associated with the automotive industry since 1898, starting with the Stanley brothers in experimentation work at Newton, Mass. Later he was president of the Elgin Motor Car Co., Chicago, and vice-president of Willys-Overland. He became general sales manager of Prest-O-Lite Battery Corp., then president and general manager after it was purchased by Electric Auto-Lite. He had been a vice-president of Electric Auto-Lite since 1937.

Obituary

Capt. William Sparks, 70, co-founder and former president of the Sparks-Withington Co., Jackson, Mich., died May 13 at Jackson after a long illness. He was plant manager of the Withington Mfg. Co., which made buggy accessories, until it became the Spark-Withington Co., one of the largest manufacturers of automobile horns and radiator fans. He retired as president several months ago due to ill health, being succeeded by his son, Henry G. Sparks. He was a liberal contributor to charities and civic development in Jackson, and was mayor of the city for three terms.

Leslie L. Vivian, 52, director and vice-president of Continental Motors Corporation, died May 18 at Plainfield, N. J. after a short illness.

CALENDAR

Conventions and Meetings

SAE Diesel Engine & Fuels & Lubricants Mtg., Cleveland.....June 2 and 3

SAE War Materiel Mtg., Detroit, June 9 and 10

Automotive Engine Rebuilders Assoc., Cincinnati .....June 15-17

SAE Nat'l Tractor Mtg., Milwaukee, Sept. 23-24

SAE Nat'l Aircraft Engineering & Production Mtg., Los Angeles, Sept. 30-Oct. 2

Edsel B. Ford

Edsel B. Ford, 49, president of the Ford Motor Company and the only son of Henry Ford, died May 26 at his home in Detroit after a brief illness.

When he was 25 years old, Edsel Ford was made president of and became active in the management and direction of the Ford Motor Company, which had been developed by his father during Edsel's lifetime into one of the largest of the world's industrial organizations.

After leaving school in 1912 Edsel Ford went to work in the old Highland Park plant of the Ford Company at a time when the company's output was approximately 180,000 cars a year. He was elected vice-president in 1917 and, in 1919, after all minority stockholders had been bought out by the Ford family, he was made president.

4-Engine Bombers

(*Continued from page 45*)

Pontiac Motor Division manufactures two potent anti-aircraft weapons—the 20-mm. Oerlikon and the 40-mm. Bofors. Four hundred and nine of the 565 parts in the Swiss-designed Oerlikon have been redesigned by Pontiac engineers. Fisher Body assembles 90-mm. anti-aircraft guns and also makes the gun mounts, while Buick furnishes traverse mechanisms and Chevrolet makes the barrels. Fisher Body also makes breech housings for 3- and 5-inch naval guns at a Detroit plant as well as other gun parts. Other GM divisions engaged in gun manufacture include Guide Lamp, Moraine Products, Delco Products, Delco-Remy, Detroit Transmission, Delco Appliance and GM of Canada.

In ordering a review of all new war plant facilities that cannot be completed by Oct. 1, the WPB recently announced, "With the exception of certain special programs, some special machinery and further expansion of raw materials production, the U. S. at last has the machine tools and the capital equipment it needs to build production to defeat the Axis. For the first time in its history the nation now has a physical plant adequate to make the maximum use of its resources in men, skill and materials." A new WPB unit will re-examine all previously approved projects for building new plants or installing new machinery to determine whether they cannot be eliminated by the use of existing facilities and machinery. Purchase of new machine tools or equipment will be banned unless it can be proved conclusively that the work cannot be done by existing facilities.

It is estimated that $11 billion of the $15 billion in new plant projects financed by the government will have been completed by June 1, leaving only $4 billion worth of unfinished facilities to be reviewed. The Oct. 1 deadline for plant completion probably will not apply to the aviation gasoline, synthetic rubber, aircraft and escort ship programs. One plant immediately affected was the new $5,000,000 factory of Liquid Cooled Engine Division of Aviation Corp. at Toledo. This plant was nearly ready to produce liquid-cooled aircraft engines for the Navy when WPB ordered further work on the plant to halt May 15, pending a review of the project.

President Roosevelt recently announced that the goal for 1943 aircraft production is 911,000,000 pounds compared to 291,000,000 pounds in 1942. The goal for 1944 is 1,417,000,000 pounds of aircraft, with the proportion of heavier 4-engine bombers and big cargo planes growing greater. Average plane weight in 1942 was 6,060 pounds for 48,000 planes but this would advance to 9,110 pounds in 1943 based on the previously announced production goal of 100,000 planes this year. However, some sources have revised the 1943 goal downward to 90,000 planes. Combat aircraft range in weight from 4,500 pounds for fighters to 32,000 pounds for 4-engine bombers. The president said the 4-engine bomber program is running about six months ahead of schedule. Seven of the nine major Pacific Coast aircraft companies reported their April output reached new high marks. The other two companies set no records because they were in the midst of model changes.

Briggs Mfg. Co., which converted some of its automobile body facilities to the production of wing, fuselage and other airframe parts, is shipping these subassemblies to more than 14 different companies. Briggs makes 75 different kinds of ducts, flaps and door assemblies for Flying Fortresses, eight large airframe sections, including an outer wing section, for another type plane, outer wings and wing flaps for a fighter plane and inner and outer wings and wing flaps for a medium bomber. On two principal wing jobs, April shipments gained 100 and 23½ per cent over March. Briggs also has been making belly turrets for bombers in a new Detroit plant since December, 1941. Early in 1943 a change in turret models was made. Each turret has more than 2000 parts.

The creature no one knows...

IN THE HALF-WORLD between day and night, an eerie, sinister creature emerges from hiding. Its ancestry is unknown. It is the bat, the only mammal which flies. Of all the creatures known to man, bats are the most mysterious. They do not mate when other animals do. And no one knows where they go at migration time.

Yet bats are the most highly specialized mammals on earth. If we had the intricate ears of bats, we could hear an ant walking. If we had their incredible coordination, we could fly at the speed of a locomotive toward a telephone wire...at dusk...yet miss it! Or dash blindfold around hundreds of objects and not touch one!

But if you think **that's** specialization, listen to this: The production giant of the machine tool industry—Cone's multiple spindle automatic lathe—can do as many as 8 different jobs simultaneously...in a matter of seconds...or perform as many as 17 different operations on a part—more than one every two seconds—with the deftness of a master craftsman!

The prime task of Cone Automatic Machines today is to help speed war production. In the future, by making possible increased production, they will increase purchasing power...and so increase employment. As a result, Cone Automatics will make major contributions to social and economic gains of the future.

CONE Automatic Machine Company, Inc., Windsor, Vermont

Production Operations at Willow Run

(*Continued from page 37*)

The center wing is produced in a number of separate stages, starting with the wing covering, then assembly in massive vertical master fixtures. A feature of the huge assembly fixtures for the center wing is the overhead movable beam, so designed as to permit the rolling of it to one side on a track, thus making it possible to quickly remove the completed wing section from the fixture with an overhead crane and to begin another wing within an hour.

When the center wing section assembly has been completed and removed from the fixture, it undergoes "clean-up" operations, and is then moved to a huge milling and drilling machine in which the engine mount pads are milled, bored, and faced in one setting. This operation assures interchangeability and precise alignment of all sections of the bomber, providing a unique advantage when it is considered that many of the center sections produced here are shipped to other plants for assembly.

Upon completion of this operation, the wing is lifted from the machine and set on a transfer car. The end plates are removed and are replaced by trolley plates fitted with rollers. The wing then is moved into a slowly moving horizontal conveyor for installation of fittings. At this stage, the center wings move along two parallel trolley lines. The line carries the center wings through a paint spray booth, then elevates into a position for the installation of oleo struts and landing gear, this operation being checked by means of portable hydraulic test stands.

Following this, the trolley line takes a third rise. At this stage, the center wings earmarked for shipment to outside assembly plants are permitted to move to the end of the line where they are taken off by the overhead cranes. The sections designated for assembly at Willow Run are lowered onto a conveyor line about five feet off the floor, where superchargers and nacelle panels are added.

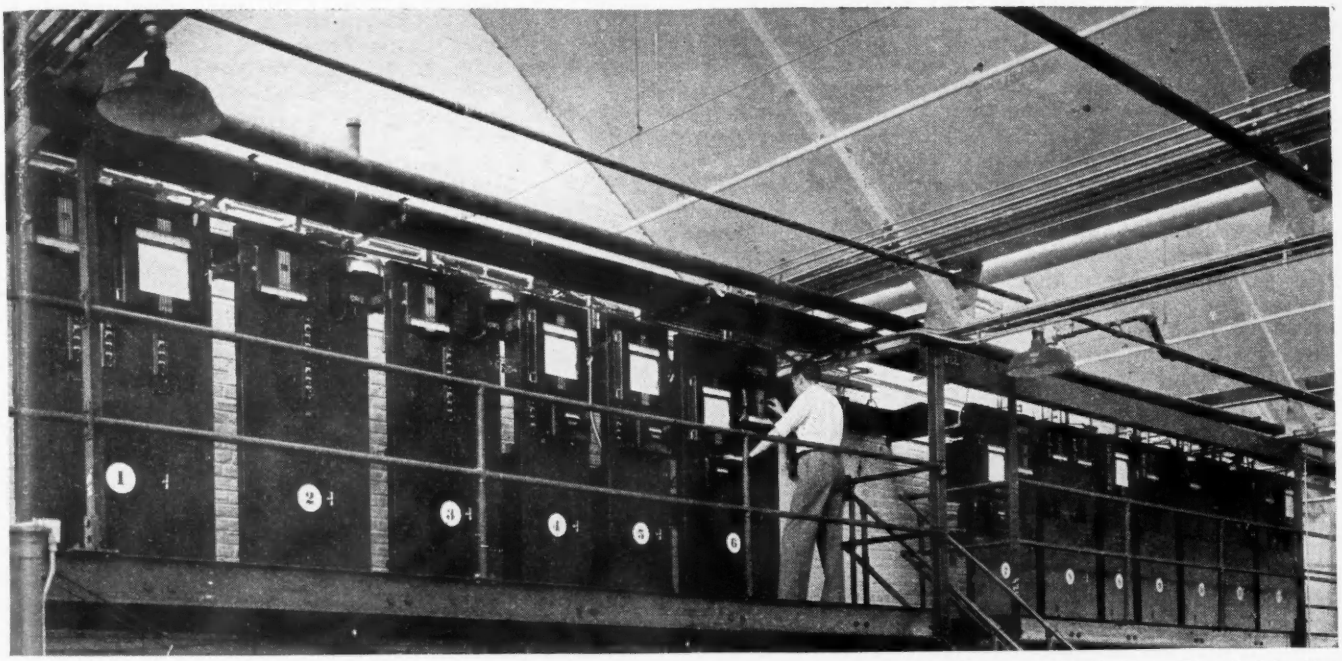
Meanwhile, the assembly of other parts of the airframe—the fuselage, outer wings, pilot's floor, bomb bay doors, tail surfaces, etc., proceeds apace in other parts of the plant. The fuselage consists of two principal sections —fore and aft—each of which is built up independently for ultimate assembly to the center wing section. A special feature of the aft fuselage assembly, which distinguishes Ford practice from that of Consolidated, is the trick of building the tail cone separately so as to break down the assembly into smaller units more consistent with mass-production methods.

Upon completion, the fore and aft fuselage sections are hoisted by crane from the assembly fixtures, and are set on cradles on a mezzanine from which they are distributed either to other assembly plants or are fed to the primary assembly lines.

Ford practice has resulted in the development of a number of distinct types of assembly fixtures, each one designed to facilitate the work of assembly, and each one tailor-made to suit the requirements of a particular airframe section. Generally speaking, there are two basic types of fixtures—the massive vertical type, such as is used in the assembly of the center wing; and the trunnion type fixture which enables the operators to rotate the work into convenient working positions. In addition, there are some massive box type fixtures in which are erected the large units such as the fuselage, side panels, tail cone, etc.

One of the major problems in an operation of this kind is the fabrication of long, slender parts which have no backbone supporting members. An example of this is the outer wing trailing edge. It is built up in a long but extremely rigid rotatable fixture and is carefully handled to prevent misalignment or distortion.

The outer wing assembly, an extremely large section ordinarily, although dwarfed by the center wing section of the Liberator, is assembled



Photos courtesy Bendix Aviation Corp. and Westinghouse Elec. & Mfg. Co.

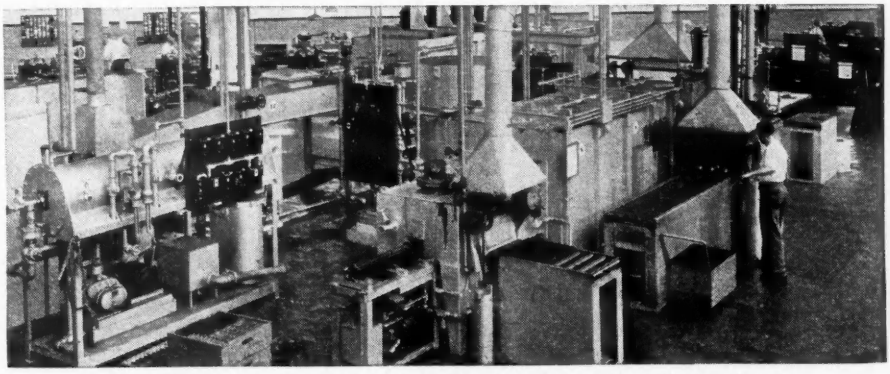
Heat-treat foreman setting a Micromax Model C Pyrometer to regulate temperature of a hardening furnace. All control panels shown were completely assembled and factory-wired by us, for greater speed and dependability in equipping the heat-treat department of a huge aviation-equipment plant.

CENTRALIZED PYROMETRIC CONTROL
For Rejection-Free Heat Treatment

Control over the temperature of an entire battery of airplane-parts furnaces is centralized in the Micromax Pyrometer panel shown above. Temperature ranges include those for bright hardening, tempering, low-temperature annealing, cyaniding, and other heat-treating operations. The furnaces range in size from an 80-kw unit, hardening about 500 lb per hr, down to 30-kw furnaces.

The Micromax Pyrometers used here are of two types—Model S Strip-Chart Indicating and Recording Controllers and Model C Indicating Controllers. Both models are fully-automatic, with such features as self-standardizers and automatic reference-junction compensators. In general, Model C is used on the first zone or zones of multi-zone furnaces, and Model S Strip-Chart Controllers are on all single-zone units and on the last or highest-temperature zone of multi-zone furnaces. Both models have the characteristic of micro-responsiveness, which enables them to "feel" a temperature change and act to correct it, while it is extremely small—so small that control action may begin before the eye can detect the motion of the controller's temperature-driven galvanometer. As a result of this micro-responsiveness, temperature is not only held within narrow limits, but is held with the steadiness essential to high-quality, high-uniformity production.

Micromax Pyrometers are now available with their own accessories (except valves) for regulating the supply of electricity, gas, oil or steam; accessories designed especially to match the sensitivity, responsiveness and dependability of Micromax. If you have a wartime control problem involving the control of any industrial temperature, our engineers are at your service. Or, if a catalog will serve your purpose, outline your problem and we will send the appropriate publication.



Battery of electrical furnaces for heat-treating both large and small aircraft parts.

Jrl. Ad N-33-620(6)

ARMY NAVY *depends on me!*

A Slogan For All Americans

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

in vertical fixtures and completed on a special monorail conveyor line.

Needless to say, there are many other activities too numerous to mention in this brief summary. They represent facilities for producing the variety of parts that go to make up this huge bomber. For example, there is a large department devoted exclusively to the fabrication of hydraulic tube harness. Here the tubing is cut to length and bent to form, then assembled into harness groups. Another small but self-contained department is the engine dress-up line. Here the engines are mounted on a closed chain monorail conveyor and are fitted with accessories and attachments ready for installation on the final line.

Final assembly consists of two major sections—the first of these, as mentioned earlier, consists of four parallel trolley lines carrying the center wing; the second converges to two lines. Among the major steps of assembly are the following: at station 1 is added the canopy which is attached to the top of the center wing section. At station 2, the center wing section is rolled onto a platform supported by hydraulic rams permitting precise positioning of the wing on locating points in the mating jig. Here are installed the bulkheads, longeron bomb racks, and side panels of the bomb bay area.

The fuselage fore section is joined to the center wing in a second mating jig in which the wing section again is lowered y means of hydraulic jacks onto four center pillars to maintain the same alignment as was established in the first mating jig. Then follow operations at other stations for the installation of wiring harness, hydraulic harness, etc. Then at station 8, the assembly moves into the third major mating jig for the assembly of the aft fuselage.

At this station, the nose wheel assembly is added and the entire ship is raised by the hydraulic jacks to permit lowering of the landing gear into normal position so that the plane will roll on its own wheels.

From this point on the various details are added—engine installation, empennage assemblies, trailing edges, etc.

At the end of this group of operations, the four primary lines converge into two final assembly lines on which the final installations are completed. On these lines, the ships move progressively from station to station, each station being provided with platforms which permit of ready access to any part of the ship.

Finally the ships emerge from the assembly bay and are rolled onto turntables in the floor which turn them ninety degrees for the final leg on the trip to the flight test.

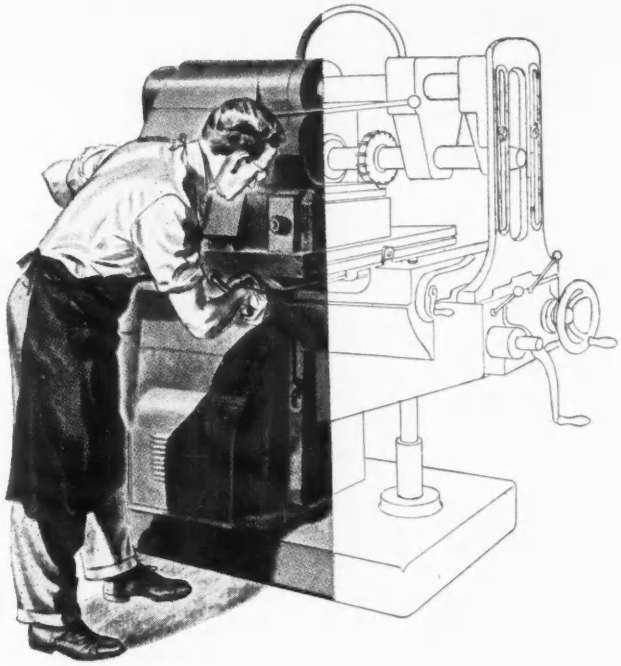
The first operation after leaving the assembly department is metal cleaning of the entire ship. This is done in a huge chamber in which a group of operators go over the entire exposed area thoroughly to prepare the metal for painting. Upon completion of this job, the ship is wheeled through doors leading into an adjoining chamber for camouflage painting. The spray booth, large enough to completely contain the huge Liberator, is shaped to conform to the profile of the ship so as to facilitate the removal of fumes and overspray.

Plasticized Materials

(*Continued from page* 22)

before, so that we can obtain approximately the same strength ratio. Another problem in molded plastics is the extreme cold encountered at high altitudes. Many molded plastics have a tendency to brittleness and to subsequent failure. This calls for a cold test to be run on every molded plastic part.

The field of molded plastics has not been more than scratched at present. A new product is constantly coming into the market and its uses are manifold. It is quite safe to predict that within the next year or two the use of both plasticized wood and molded plastics will be expanded many times over, not only in the aircraft industry but in all types of fabrication.



Getting Work Out of the OTHER HALF

This is half a machine. It cost full price, takes up full floor space, uses full operator's time—but it's just half a machine. That's because it is handicapped by a slow setup and removal cycle. It delivers only a part of its potential output.

One of the most important duties of **HECKER** tools, jigs and fixtures is to convert stand-still time into production.

The **HECKER** tool engineer takes account of the worker, the machine and the requirements of the job. Then he designs a tool to bring those three vital factors into the best possible adjustment.

HECKER tools have other purposes, too. It depends on the results wanted. Tools for inexperienced workers; tools to improve quality; tools to speed operating cycles; in short, custom-designed tools, built to the specific problem.

These engineers can see their own designs in daily operation on precision aircraft parts in the **HECKER** plant. That's an extra advantage in firsthand production experience which can help you get more work out of the "other half" of your machines. By way of demonstration, turn a real tooling problem over to **HECKER**—judge for yourself. Write (wire or phone if urgent) to A. W. Hecker, 1984 East 66th Street, Cleveland, Ohio; or, 517 New Center Building, Detroit, Michigan.

A★W★ *Hecker*

DESIGNERS AND BUILDERS OF TOOLS, JIGS AND FIXTURES . . . FABRICATORS OF AIRCRAFT PARTS

New Products for Aircraft

(*Continued from page 39*)

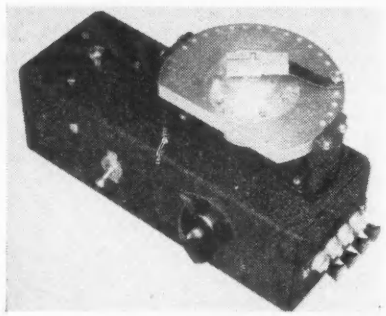
tactor is due largely to its balanced armature construction.

The new contactor conforms to the stipulations of various government agencies with respect to ambient temperature range and corrosion-proof qualities, and is said to be suitable for use at altitudes from sea level to 40,000 feet. It can be mounted in any position on either a metal or nonmetallic base.

The contactor is also available in both these sizes in a form which, while utilizing the same parts, is equipped with a simplified mounting bracket and terminal assembly. This form represents a slight saving in size and weight.

Aircraft Autosyn Voltage Calibrator

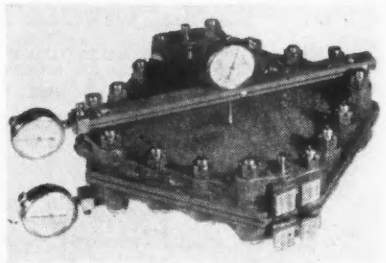
The Model No. 7 Aircraft Autosyn Voltage Calibrator and Polarity Indicator has been brought out by Televiso Products Co., Chicago, Ill., for use in the manufacture and production testing of aircraft autosyn indicating motors. It may also be used by military inspection stations and repair depots. The unit is used in connection with a vacuum tube voltmeter and a 400 cycle power source. It is furnished with or without power supply and voltmeter.



The Model No. 7 Autosyn Voltage Calibrator and Polarity Indicator

Tester for Plywood

The Streeter-Amet Company, Chicago, Ill., announces a device for testing tensile strength of wood veneers. It is called the Streeter-Amet Tester, and uses flat specimens requiring no special preparation before testing.



Fixture for Testing Plywood in Shear

Specimens are clipped from veneer or sawed from thin plywood panels, in rectangular shape 1 in. wide by 8 in. or more in length. Test data for comparative purposes are instantly available by direct reading of the pressure. The load in pounds is read directly on a pressure gage. A special fixture is available for testing plywood in shear.

New Development in Wartime Packaging

Lumarith laminated Ordnance paper, which includes a lamination of Lumarith foil, is being used to protect finished and semi-finished products such as roller bearings, machine parts and firearms from water, dust, grease, oil and moisture. The lamination of Lumarith is a product of Celanese Celluloid Corporation, New York, N. Y. This non-corrosive plastic lining is not affected by extremes of humidity or temperature, and does not dry out, shrink or become brittle.

TO FABRICATE A MILLION STEEL UNITS OF ANY KIND OR SIZE IS A HIGHLY WORTHWHILE JOB. TO PROGRESS SMOOTHLY THROUGH MILLION AFTER MILLION ON A MAJOR ARTICLE OF WAR IS A PROUD EXPERIENCE FOR ANY MANUFACTURER.

THE *Parsons* CO.

Focke-Wulf FW 190-A-3 Fighter

(*Continued from page 38*)

801A engine supercharger case it appears that the supercharger of the 801D has two speeds, automatically controlled by the master engine control. There is no special provision for hot air intake to the engine, though pre-heating of the induction air occurs as it passes over the cylinders.

Hydraulic Master Control

At the rear starboard side of the engine there is a hydraulic master control box which, as previously mentioned, automatically regulates the propeller pitch, mixture strength, boost pressure, magneto timing and throttle position. This control works in unison with the pilot's throttle lever and relieves him of the need to select the desired mixture strength and supercharger gear. An extra lever in the cockpit leads to this control box. Its movement is a method of ensuring priming of the oil supply to the mechanism on starting if the throttle response is sluggish. For starting, provision has been made as follows: A small tank in the cockpit, containing priming fuel, feeds to the rear bank of cylinders. One of the oil scavenge pump pipes has a connection for the introduction of hot oil from a ground supply. There is a device for diluting engine oil with gasoline, and provision for starting from either the aircraft battery or from an outside battery.

Exhaust System and CO Elimination

Exhaust pipes face rearward and are flattened to facilitate their fitting inside the nacelle; none projects. Their distribution is four each to the port and starboard sides of the nacelle and four to the bottom, two of the latter each exhausting from two cylinders. The single exhaust exits are approximately elliptical, 3 in. x 1½ in., while the other two are approximately rectangular, 3¼ in. x 1½ in.

The exhaust outlets are plain, without any flame damping device, and no provision for exhaust screens is visible.

Immediately aft of each of the side sets of outlets there are three louvres forming the main exits from the cowling for cooling air. Thus between the exhaust gases and the side of the fuselage a layer of air is interposed. The pilot's compartment is sealed off from the rest of the aircraft with great care. Control rods, where they pass through the bulkhead, are sealed by concertina rubbers. A fabric bulkhead is placed across the rear end of the fuselage about 60 in. from the tail.

Electrical Installation

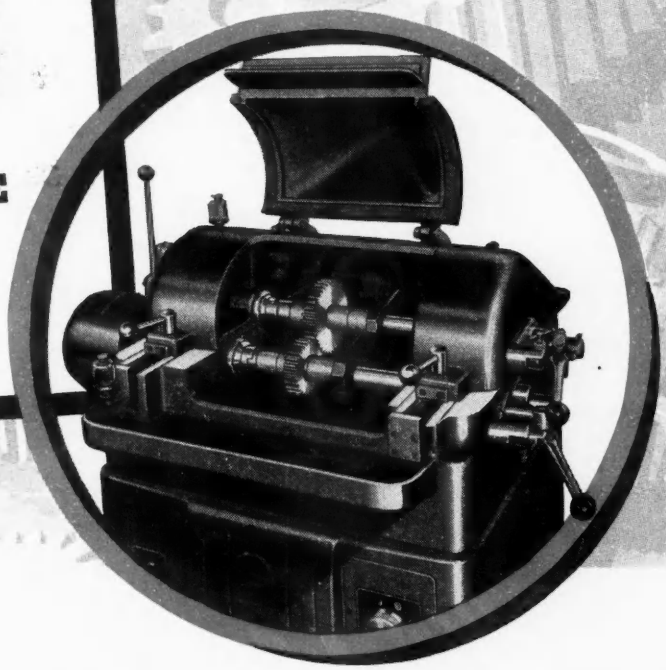
Interest attaches to this machine in that it is the first small fighter to be seen which is practically "all-electric." In general the wiring scheme is similar to that used on other German aircraft, except that the standard terminal blocks are not used. Instead, there is a new type of block, with appropriate internal inter-connections, and plug and socket connection to the external circuits. This method of connection is used at each wing root and at the main switchboard, and there may be also other connector boxes that have not yet been seen. Plugs and sockets at the junction of engine and fuselage are of standard Bosch design.

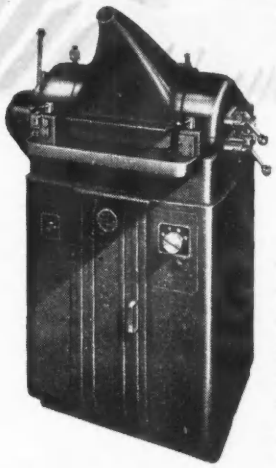
Electrical power is supplied by a 24-v 2-kw generator with a 24-v 10-amp-hr alkaline battery, mounted behind the pilot's seat. This type of battery is a notable point of difference from other aircraft systems.

The undercarriage is retracted electrically by a motor for each main leg. There is an electrical device for locking the undercarriage legs in the retracted position. Indication of the position of the undercarriage is by lamp and warning horn.

There is one electric motor on each side for operating the flaps. Three selector buttons on the switchbox are a red one to retract the flaps, a yellow one for "Start," which gives 10-deg extension and a green one by which the flaps are fully lowered. If the buttons

FIND OUT WHETHER GEARS ARE NOISY *before* THEY ARE ASSEMBLED





The RED RING Gear Sound Tester will tell you immediately whether any pair of gears will be noisy in operation. By the character of the sound noisy gears produce at various speeds, you are able to diagnose the cause of their noise and provide a remedy.

The RED RING Gear Sound Tester consists essentially of a sound chamber in which the gear set being tested operates, and a special acoustical horn which amplifies gear sound fifty times. The sound chamber excludes outside sounds so that the inspector hears only that made by the gears inside. For that reason it may be used anywhere, even in a noisy shop.

Gears may be tested under light brake loads at four speeds and in both directions of rotation. The center distance between test gear spindles is adjustable and set with precision gage blocks.

SPECIFICATIONS

	GSC-10"		GSLX-18"	
APPROXIMATE CAPACITIES	**SOLID SPINDLE**	**HOLLOW SPINDLE**	**SOLID SPINDLE**	**HOLLOW SPINDLE**
Maximum Gear Diam.	10"	10"	18"	18"
Max. Length between Centers	11"	11"*	14"	14"
Distance between upper and lower spindle	1¾" to 5½"	2½" to 5⅝"	3¼" to 10¾"	3¼" to 10¾"
Gears with Stems		½" to 1½" Dia. of stem		½" to 1⅞" Dia. of stem
Spindle R. P. M.'s with Standard pulleys	500, 800, 1050 and 1600		750, 1150, 1550 and 2300	
Net Weight	1200 lbs.		2040 lbs.	

**Can be varied to suit individual requirements. (Consult Engineering Dept.)*

Write for descriptive bulletin.

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

NATIONAL BROACH AND MACHINE CO.
RED RING PRODUCTS
5600 ST. JEAN · DETROIT, MICH.

are not pressed fully home and locked, but just held down, any intermediate flap position can be obtained. Position indication is by means of three lamps—red, yellow and green for "in," "start" and "out" positions, respectively.

Tailplane incidence is altered by means of an electric motor operated by two push buttons in the cockpit. There is a moving coil indicator calibrated in degrees of incidence. An immersed electric pump is fitted in each of the fuel tanks. Each is separately controlled by switches, and luminous indicators on the instrument panel show when one of the other of the pumps is switched on. Provision is made for two cameras, one in each wing, and at least one of these is a gun camera, the circuits being connected into the gun firing circuits.

Armament

The armament of the machine examined consisted of the following guns, all fixed and firing forward: Two M.G. 17 machine guns (7.92 mm) located on top of the engine under the cowling, two M.G. 151 cannon (20 mm) modified to fire electrically detonated cartridges and synchronized electrically to fire through the arc of the propeller, two M.G. F.F. cannon (Oerlikon 20 mm), one in each wing outside the propeller disk. The M.G. 17 machine guns are cocked and fired electro-pneumatically. The M.G. 151 cannon are cocked and fired electrically, while the Oerlikon cannon are cocked electro-pneumatically, but fired electrically. Indicators are provided in the cockpit showing the number of rounds left unfired.

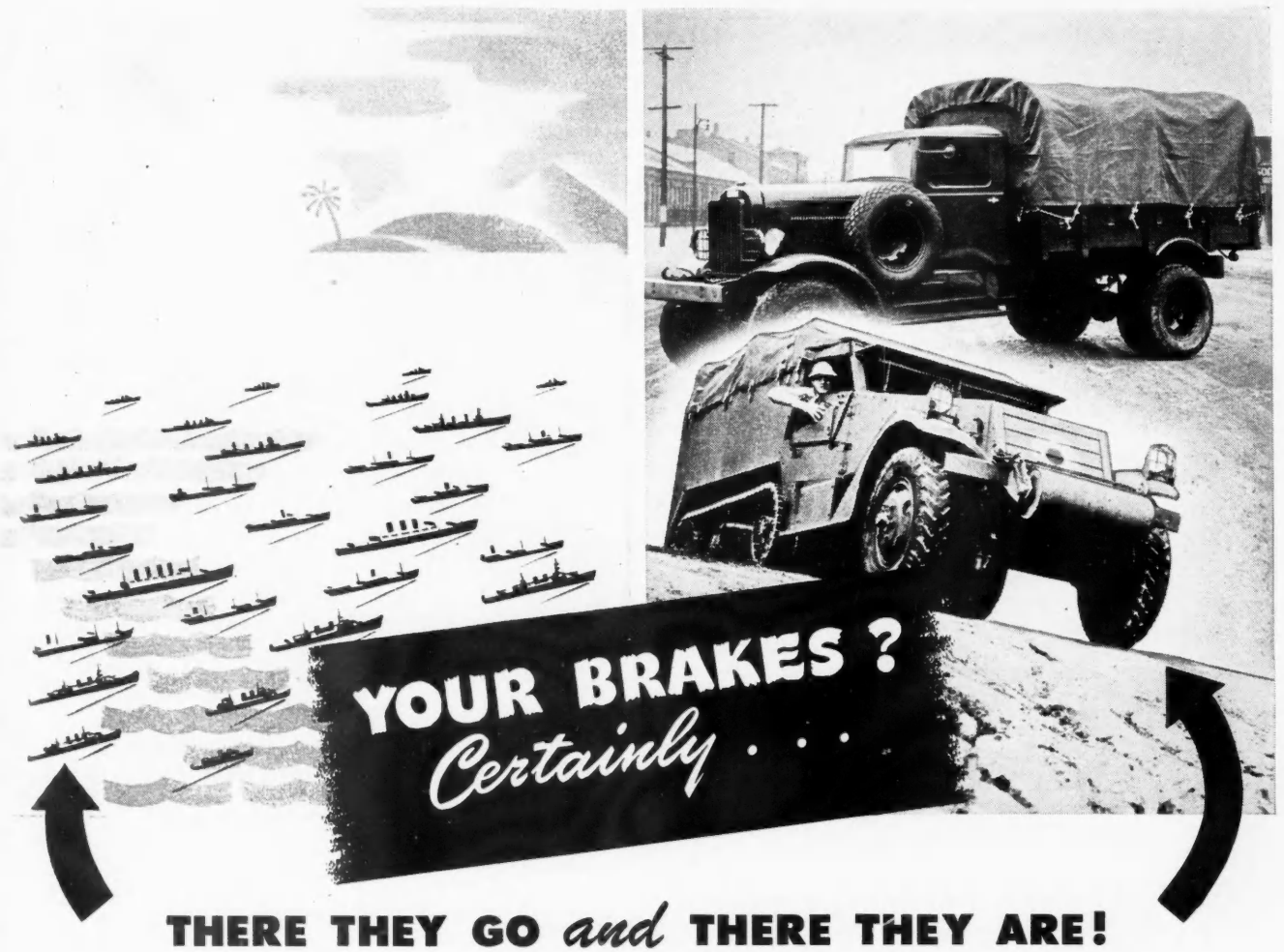
The auxiliary equipment included the following items: A standard Revi C.12D reflector gunsight, rounds counters for each gun, a "fire-selection" device enabling the pilot to fire any pair or combination of pairs of guns, and devices by which the guns could be cocked by the pilot during flight and which automatically return all guns to the cocked position about one second after releasing the firing button.

Protective Armor

The pilot is protected from frontal attack by the engine and a bullet-proof windshield, while from the rear he is protected by armor plate of thickness as follows: Bulkhead behind pilot's head, 14 mm; back of seat (formed to shape), 8 mm; four small panels behind the seat, each side, above and below the back of the seat, 8 mm. There are two rings protecting the oil cooler and oil tank at the front of the engine, about 4.5 and 3 mm thick, respectively. Together they cover the front 12 in. of the engine cowling.

Oxygen Equipment

Three dural bottles of a new type are carried in the floor of the fuselage just aft of the radio equipment. A Draeger economizer is fitted of the type used in the Me 109F and Do 217. A gage showing the pressure in the bottles is mounted on the dashboard, together with the main valve.



THERE THEY GO *and* THERE THEY ARE!

When *you* make the trucks, half-tracks, jeeps and other war equipment, don't you get a kick out of hearing of something that could not have happened without the units that come off your production line?

And you don't, in any sense, boast about the great things you are doing for war when you tell your friends about it. The gladness comes because *your* production is helping bring this war closer to its end.

That is exactly how we feel about the fact that TRU-STOP *Emergency* BRAKES are on so much of the mobile fighting and transport equipment. We would cheer if news came that no more of them were wanted for war—that victory had made it possible for us to swing over to brakes for motor trucks and busses to operate on our own highways and streets.

If you are pointing your thoughts in that same direction, we will be most happy to talk things over. Peace may not be just around the corner, but don't let either of us be caught flat-footed when we get that welcome news.

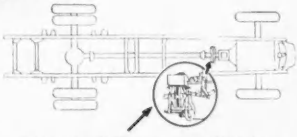
TRU-STOP *Emergency* BRAKES

AUTOMOTIVE AND AIRCRAFT DIVISION

6-235 GENERAL MOTORS BUILDING • DETROIT, MICHIGAN

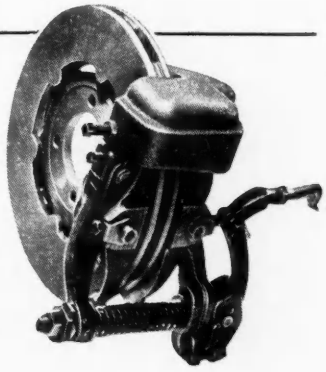
695 BRYANT STREET • SAN FRANCISCO, CALIFORNIA

In Business for Your Safety



TRU-STOP *Emergency* BRAKES

TRU-STOPS are manually-operated propeller shaft emergency brakes of disc type. A flow of air is driven across both discs by vane construction that rivals the efficiency of well-made pressure pumps—dissipating the heat of braking that destroys the linings of other brakes.



A Division of AMERICAN CHAIN & CABLE COMPANY, INC. *Bridgeport, Conn.*

Two Pack Truck Shipments

(*Continued from page* 19)

shipped. All engines received at Chevrolet-Bloomfield have been given a coating of rustproofing mixture on the cylinder walls and on moving parts at the factory to protect the engine during shipment. This mixture is a combination of rust bond and motor oil. The engines are sealed for shipment.

Weight and size are the limiting factors in the boxes used to carry the knocked-down trucks. Maximum weight for a box is 6720 lb or three long tons, based on the capacity of derricks used for loading and unloading cargos at ship side. Size of the box is limited by the bulk that can be easily handled in transit. Engines, which weigh 542 lb each, are packed eight to a box, thus requiring three boxes for each shipment of 24 trucks. Batteries and carburetors also are packed in the engine boxes. Eight rear axles are packed in a box, and certain standard parts are included in every third axle box. Twenty-eight tires and wheels comprise another case.

All boxes are internally braced according to Army specifications in order to help distribute the weight evenly. Each box must be packed so that it will ride well with either side on top. In fact, the amount of bracing in the boxes has been increased 20 per cent over peacetime export requirements due to the rougher usage which the cases may get under wartime conditions. Two by fours are nailed to the sides and ends of the cases to increase rigidity and to prevent crushing due to high stacking in storage. To take the weight strain off the case bottoms, axles and motors are secured in wooden cradles in the box. Lumber used on the outside of the cases is of 11/16-in. thickness and must be of No. 2 common or better yellow southern pine.

Thirty-five cases in 22 different sizes, plus two separate bundles, make up a single shipment for 24 trucks. The boxes in the shipment range in weight from 1000 to 6600 lb. These boxes are fabricated at Chevrolet-Bloomfield from pre-built panels. Each unit of 35 boxes requires 6773 board feet of lumber for construction and 1210 board feet for internal bracing. Consumption of lumber runs into millions of board feet in a year.

After the boxes are sealed with a water repellent cover and stenciled they move out the ends of the packing lines to the loading dock. From there they are hoisted into freight cars for shipment to seaboard, which is only a few miles away, or to a motor vehicle pool somewhere in this country.

The Two-Unit Pack is an outgrowth of the war and the need for shipping trucks directly to combat areas where plant assembly facilities are not available. These trucks can be assembled with simple hand tools and a chain hoist, if necessary. Early in the war a single unit pack was developed for Chevrolet 1½-ton 4x4 Army trucks. This consisted of a chassis case and a two-unit cab case. Stowage space for the three cases containing two trucks was 1460 cubic feet, or 730 cubic feet per truck. However, this pack failed to utilize efficiently the critical cargo space on war-bound convoys.

So with the cooperation of Army Motor Transport engineers, the "Fairlawn pack" was developed as the outgrowth of a clinic held at Fairlawn, N. J. In this method, the trucks are partially dissembled and the parts for two vehicles are packed into three cases. One box contains two chassis assemblies, another two cabs and a third the four axles. The cubic content for these three cases is 623 cubic feet, or 311 cubic feet per truck. This marks a saving in shipping space of 102 per cent. In other words, more than twice as many trucks now can be shipped in a given amount of cargo space than could be transported with the old single unit pack.

Another building at the Chevrolet-Bloomfield plant houses the two-unit

(*Turn to page* 69, *please*)

(*Continued from page* 64)

boxing operations. The completed trucks are shipped in by freight car after having been built, road-tested and approved by Army inspectors at a midwest Chevrolet assembly plant. After the truck is unloaded from the freight car, the oil, water and gasoline are drained out. Then the truck is brought inside the plant and put on a disassembly line, which is an assembly line in reverse. Certain parts are removed systematically from the truck as it moves along, each part being tagged with No. 1 or 2 and the truck engine number to identify it. As the parts are disassembled, they are put in the proper place for subsequent packing into the appropriate case in the TUP.

Largest box in the pack is the chassis box, which measures 233x50x43 inches and weighs 6640 pounds. This contains two chassis with the engins attached, one chassis upsidedown on top of the other. The radiators, hoods, spare tires and mufflers also are stowed away compactly in this box, which can be packed in four minutes by expertly trained workers at Chevrolet-Bloomfield. Another box contains two cabs, with six wheels and tires inside each cab, fenders, gasoline tanks and seat cushions. This weighs 4116 pounds. The third case contains two front and two rear axles together with the brush guards and various standard parts, and weighs 3450 pounds. A separate body bundle, containing two partially knocked down cargo or dump bodies or two wood cargo bodies, completes the shipment.

All parts in the cases are tagged for the No. 1 or No. 2 vehicle as well as the engine number to assure that the same parts are assembled into the truck when it reaches the port of debarkation. The three cases comprising a Two-Unit Pack also are stenciled with the same serial number on the outside so they will be shipped together and unloaded at the same port. Each case contains a packing list of itemized parts in a waterproof envelope, while an assembly operations manual with all details for reassembling the trucks is placed in each chassis case.

Complete protection must be given the cases in the Two-Unit Pack against salt water, moisture, frost and other climatic conditions due to the global nature of the war and the likelihood that trucks may be shipped to any part of the world. All cases are lined with waterproof kraft paper. Then a fibreen waterproof liner is inserted into the built-up case completely enclosing the contents. The liner is sealed with hot asphalt as a further protection. The entire top of the case is covered with a layer of cold patch, an asphalt compound, and over this is placed a sheet of water-repellent paper which provides protection against the weather. This same type of protection also is given to CKD shipments. Name of the company and other data are stenciled on the outside of each case with black metal ink. All this protection is necessary because the cases may have to be dumped from shipboard into shallow water close to a combat zone and then retrieved at low tide by the forces ashore. Or they may stand for months in wind and weather at a motor vehicle pool in this country awaiting shipment abroad. They also may be exposed to a great deal of salt water on the voyage overseas.

Chevrolet-Bloomfield is a major factor in delivering this packaged transportation in comparatively small boxes to all parts of the battlefront in the second World War.

Lincoln Foundation Announces Awards

In the Engineering Undergraduate Award and Scholarship Program of the James F. Lincoln Arc Welding Foundation, the following winners were announced: First—Herman J. Brenneke, New York University; second—Robert Edison Lee, Iowa State College; third—Charles L. Sammons and John H. Stewart (co-authors), The Ohio State University. In addition, there were four fourth awards, eight fifth awards, twelve sixth awards, and fifty seventh awards.

Daimler Armored Car

(*Continued from page* 41)

disturbance on the uneven ground and steep grades.

Like the engine, the radiator is also at the rear, transversely arranged behind the powerplant. Air passes to it from a space between the side panels and the lipped edge of the armor plate above the engine. A large fan draws the air back through the radiator and discharges it through armored slots at the extreme rear.

The transmission, which embodies Daimler car and bus practice, combines a hydraulic coupling and a unit-constructed pre-selective epicyclic gearset. The fluid flywheel is of an improved type with increased efficiency at low speed, while the gearset provides five speeds and has a top gear clutch of new design.

From the pre-selective gearset the drive continues through a Tracta constant velocity universal joint to a transfer gearbox providing a reverse on all speeds, a neutral position and a differential; also gears converting the single central drive into twin drives, one on each side. From these twin drives four propeller shafts run fore and aft, alongside the channel of the frame side rails, to enclosed spiral bevel gears driving each of the front and rear wheels independently. Thus there is a propeller shaft to each wheel. The differential, acting between the left and the right wheels, does not allow diagonal wheelspin to occur. The four bevel casings are located within the channel of the frame side rails and are attached to the latter. From them the drive passes to the wheels through short coupling shafts with Tracta universals having a permissible angle of 40 deg. With no central propeller shaft or axle casing for bevel gears and differential, the rear engine can be set low in the chassis, particularly in view of its dry sump and separate oil tank.

The independent suspension, which allows an 8 to 10 in. range of vertical movement to the wheels relative to the frame, is conventional in principle. The assembly adjacent to each wheel consists of a pair of broad links, one above the other, pivoted at their inner ends to the frame and at their outer ends to the hub assembly. Bearing on a yoke near the outer end of the upper link is a compound coil spring in compression, the upper end of this spring having an abutment within the top of a rigid outrigger bracket bolted to the frame. Maximum vertical movement is limited by rubber buffers and damped by Luvax piston type hydraulic shock absorbers.

An unconventional feature of the steering layout is that it allows for a driving position slightly on the skew, the driver's seat and the steering wheel being set at a slight angle. For this feature it is claimed that it enables the driver to see and steer either back-

We're not interested in ZOOT SUITS

but we are interested in the phenomena of change...

We're not rug cutters, and we're distinctly not "right with the rags." We don't wear a "solid suit of threads," padded at the shoulders like a lunatic's cell, with the "jut cuts" and the "reat pleats," the "cleave sleeves" and the "drape shape." That sartorial throwback of a juvenile ego is definitely not down our alley.

We're specialists in internal grinding problems, and Zoot suits (we fervently pray) won't wield their foolish influence upon the wheels of industry . . . but many a simple fad has!

When a boy and a girl once sat in a hammock, and he thrummed a mandolin and she softly sighed, "I just love your new soft collar" — the celluloid collar market quietly vanished from this earth . . . And the horse-and-buggy business employed a million men — until an explosive contraption, deplored as a dangerous fad, noisily disemployed them and put ten times their number to work.

No, we're not interested in Zoot suits, but we are interested in the phenomena of change. And this is the fastest-changing period in all of industrial history. As a result, many businesses, seemingly on the rise, are actually on the brink of failure in the post-war world of better and cheaper materials.

We've developed many new techniques in grinding these materials, and we believe that this knowledge can be of greater value to manufacturers today than ever before. Bryant's Consulting Service is available to you at all times, and we urge you to call upon us now!

SEND FOR THE MAN FROM BRYANT

BRYANT CHUCKING GRINDER CO.
SPRINGFIELD, VERMONT, U. S. A.

wards or forwards with almost equal ease, as is obviously desirable if use is to be made of the five speeds in reverse.

The steering column, sloping from the right side to the center, is in two parts, with a universally-jointed link between them where the upper part, with its relatively acute angle, is coupled to the more nearly vertical lower part conforming with the sloping front of the vehicle. The lower part of the column extends upward from a bevel gear casing, whence a universally-jointed shaft runs to a worm and sector gear. An approximately horizontal lever on the end of the sector shaft is connected to the left hub assembly and is linked also to an idler lever on the right, this lever being coupled to the right hub. The overall steering ratio is 24 to 1. A minimum turning circle of 38 ft diameter is provided.

Service brakes are Lockheed hydraulic units operated from a tandem master cylinder. Rear brakes can be applied independently by means of enclosed cables from the central hand lever.

As regards the superstructure, the roof of the turret is doubled-hinged and balanced on springs to enable it to be folded back or closed with ease. Normally it is open, and the two seats, mounted on vertical tubes, are adjustable vertically to an extent that allows the occupants to raise them sufficiently to bring the eye level just above the top of the turret armor.

When going into action, the seats are lowered and the roof closed, the forward driving vision being obtained through a port, which is protected by a hinged and balanced armor plate cover that swings outward. In actual battle this cover is closed, and the driver looks through four fine horizontal slots in the cover that are equipped with bullet-proof glass.

Entry, when the top is closed, is made through a shallow door on the left. With the top open an alternative way of entry is from above, by stepping over the front shield from the transverse tool box that forms the foremost part of the vehicle.

Besides the window in front of the driver there are two smaller ones in front of his companion, the gunner. One of these is for forward observation and the other for a Bren gun, which also can be installed on a high-angle mounting for anti-aircraft defense. The gunner's seat in its fully raised position swivels and gives him a complete traverse around the top of the turret, which is rubber edged. A protected port is also provided at each front flank, and yet another in the rear panel for driving backwards.

Within the body behind the occupants is located the fuel tank having a capacity of 22½ gal, which provides a range of about 200 miles. There also are rifle racks, stowage for the Bren gun and other impedimenta, including a radio set and storage batteries.

In front of the tool box are stout metal channels for "unditching" or getting out of soft ground. Shovels are carried on the left front fender. Between the turret flanks and the rear fenders are triangular stowage boxes. Another large box forms part of the "running-board" on the right. Extra fuel, or drinking water for desert conditions, can be carried in cans above the rear fenders. On the right front fender is a large hydraulic jack, which is held in place by a special self-locking clip.

In full battle order this Daimler Scout car, which has a wheelbase of 78 in. and a tread of 58 in., weighs approximately 6750 lb. Its maximum speed is about 60 mph. Grades of 75 per cent can be negotiated by it.

According to *The Autocar*, it is firmly believed that only because he had the use of a Daimler Scout car, captured by the Germans on a previous occasion, was Rommel able to escape from General Montgomery's men after El Alamein.

Buy More War Bonds

LUMARITH E. C.

Another Lumarith plastic in fighting shape

U. S. Army Signal Corps Right-angle Flashlight. A problem in molding which was licked by the custom molder and LUMARITH*E.C. (ethyl cellulose base).

The Army demanded great impact-strength under Arctic conditions . . . dimensional stability even in the steaming Tropics. There were converging cores to handle and the threaded sections had to be impressed to interchangeable accuracy. All the specifications were met in this sturdy piece of Signal Corps equipment.

When you convert to plastics, you will need the custom molder's counsel. If you are not too familiar with plastic production methods, here is a plan to help you:

1. Specify to us the qualities required in your finished part: impact strength, light transmission, dielectric strength, dimensional stability. . . . We will recommend the plastic for best results.

2. We put you in touch with the available custom molders best equipped to mold the piece by injection, compression, transfer, or extrusion.

3. The custom molder will give you a quotation.

4. We work with the custom molder in selecting the formulation suitable for all factors of production technique in relation to dies, heat, pressure, flow, etc. . . .

Success with plastics depends upon the right plastic and the right man at the machine.

*Reg. U. S. Pat. Off.

LUMARITH *Plastics*

REG. U.S. PAT. OFF.

CELANESE CELLULOID CORPORATION, *a division of Celanese Corporation of America,* **180 Madison Avenue, New York City.** *Representatives:* **Dayton, Cleveland, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.**

CELANESE CELLULOID CORPORATION

the first name in plastics

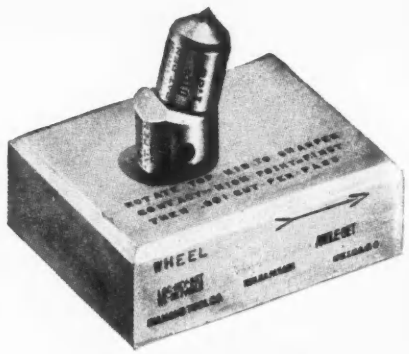
A DIVISION OF CELANESE CORPORATION OF AMERICA

New Production Equipment

(*Continued from page* 43)

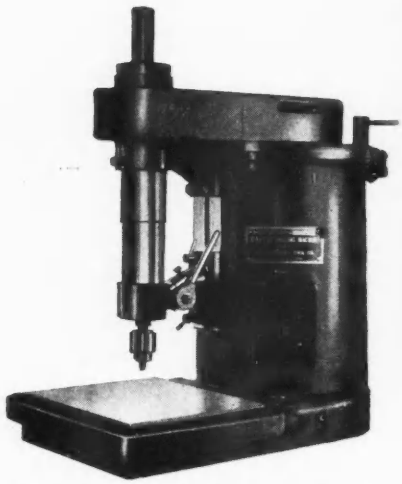
Block," 2½ in. by 3 in. by 1 in., which contains a 12 deg "Angle-Set" fitted with a Big-Hed Nib. The Big-Hed Nib has a No. 10-CNX diamond, and is equipped with two lock screws. While this dresser is designed for wheels up to 8 in. diameter, larger diamonds can be set in it for larger wheels. It is claimed that the diamond can be kept sharpened by rotating the top nib.

THE Sigourney M-100 Sensitive Drilling Machine has just been introduced by the Sigourney Tool Company, Hartford, Conn. It operates at spindle speeds of 4000, 7000, and 10,000 rpm when equipped with standard 3450 rpm motor, or at half the above spindle speeds if equipped with special 1725 rpm motor. The horizontal distance from face of column to center of chuck is 4½ in. Larger work may be handled in the Model M-100A which measures 7 in. from face of column to center of chuck. Space blocks are available, for both models, for insertion between column and base, thus increasing the distance from table top to chuck. The hardened and ground spindles, and the straddle mounted pulleys of these machines are equipped with sealed ball bearings.



Angle Set Magnet Block

Both the Models M-100 and M-100A are available in single or multiple spindle design. As each spindle is individually motor driven, the number of spindles which may be combined in one unit is practically unlimited.



Sigourney M-100 Sensitive Drilling Machine

COMMERCIAL availability of electronic induction equipment for routine brazing of carbide tools is announced by Carboloy Company, Inc., Detroit, Mich.

While based on standardized units, their use in each case is to be engineered to the needs of individual organizations—recommendations as to size of unit or units, basic coil designs, etc., being supplied by the Carboloy engineering department on the basis of the individual user's needs.

The Carboloy induction tool-brazing equipment is based on a new line of General Electric high frequency (500,000 cycle) electron tube oscillators, available in two sizes having 5 kw and 15 kw output ratings. The selection of

How to PREVENT THIS SABOTAGE to Your Screw Driving Army

PHILLIPS SCREWS END DRIVER-SKIDS!

Caught in the act by the "frozen" action photography* of Gjon Mili, is a skidding screw driver . . . one of the meanest of saboteurs. Skidding drivers cause accidents that keep all too many workers away from assembly lines, nursing gouged hands. And, fear of such injury slows-down the work of countless others. Always present, the danger increases with rushed, inexperienced workers. So, it's doubly important today to specify Phillips Recessed Head Screws . . . which prevent driver-skids!

Automatic centering of driving force in the scientifically designed Phillips Recess eliminates all other screw driving troubles: the fumbling, wobbly starts . . . re-driving of slant-driven screws . . . removal of broken-head screws . . . reclaiming of marred parts. Fast, faultless driving becomes automatic, even for "green hands" Power driving becomes practical.

They cost less to use! Compare *driving* costs. You'll find that screw *price* is a minor part of total fastening expense . . . that it actually costs less to have the advantages of the Phillips Recess.

**Gjon Mili synchronizes exposures with lightning-like flashes of the stroboscopic light, to make skidding driver appear to stand still.*

PHILLIPS *Recessed Head* SCREWS

KEY TO FASTENING SPEED AND SAFETY

The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting – Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving – Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

WOOD SCREWS • MACHINE SCREWS SELF-TAPPING SCREWS • STOVE BOLTS

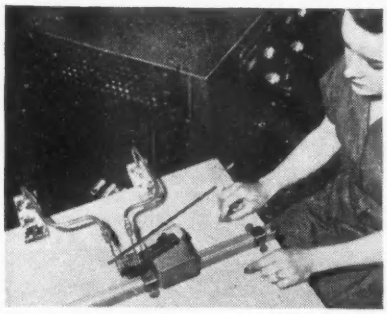
21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

the correct unit for any given installation is dependent on the sizes and quantities of tools to be brazed by individual users. The 15 kw unit is designed to accommodate larger sizes of tools as well as the brazing of production quantities of smaller tools by brazing two or more at a time. The smaller 5 kw unit is designed primarily for smaller sizes of tools.

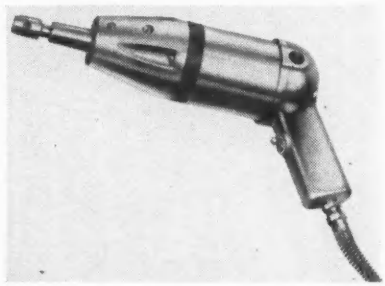
In addition to the oscillator, the only other equipment required is a table carrying a tool holding fixture or fixtures, and the necessary water-cooled coil or coils to be connected electrically to the terminals of the oscillator.

The coils may be formed from ordinary copper tubing by the user when special brazing requirements arise. Where large numbers of tools are to be brazed and the unit has sufficient capacity, it is possible to use several coils in series, so that two or more tools can be brazed at a time.



Induction brazing a Carboloy cemented carbide tool with Carboloy-G.E. electronic equipment

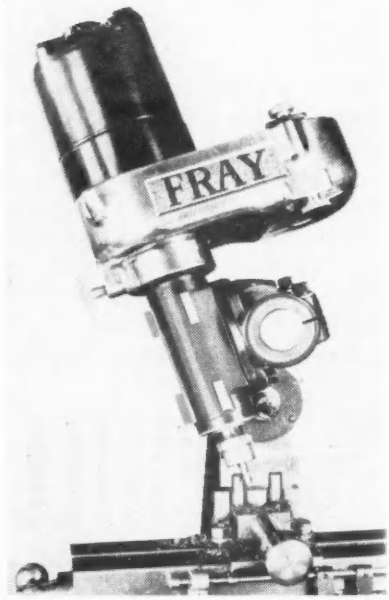
H & H Research Co., Detroit, Mich., is offering their push-and-pull action portable electric tools in two new models. Model CX has a ⅜-in. stroke; Model EX a ⅛-in. stroke. Both models have a rate of stroke of 1000 to 1200 per minute and a force of 30 to 40 lb, push or pull, developed at the working end. The work spindle is provided with three bushings instead of two, as in the older models, and a heavier armature is used. The fan, air inlets and air outlets have been redesigned for larger capacity, providing an improved motor cooling system.



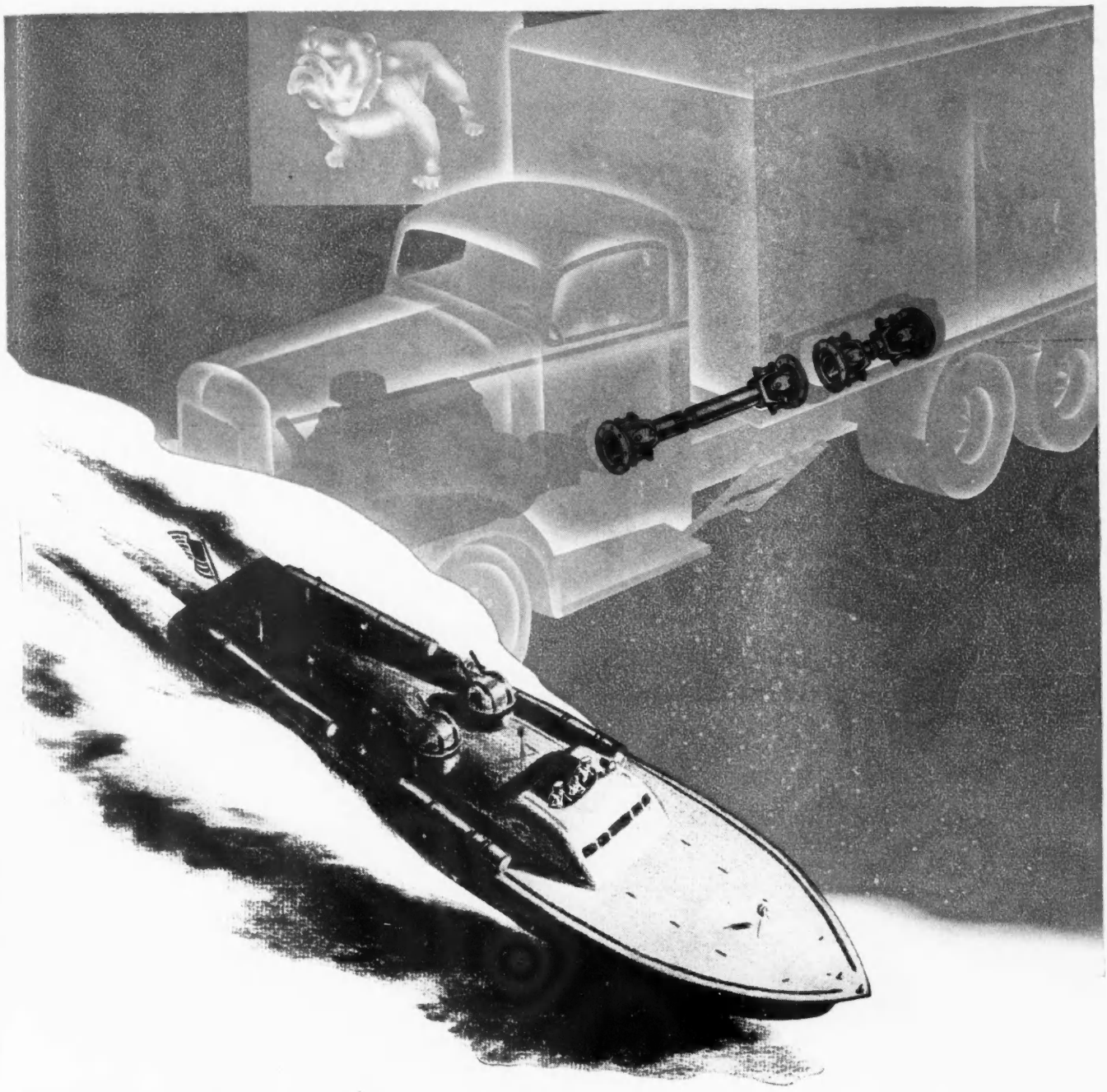
Reciprocating Action Electric Tool made by H. & H. Research Co.

A vertical milling attachment, known as Type F, is now in production at the Fray Machine Tool Co., Glendale, Cal. This new model is equipped with a ¼-hp Frayco motor, and will handle up to ½ in. end mills in tool steel. Motors are available in either 1750 rpm or 3500 rpm as required. Spindle speeds are 435, 650,

(*Turn to page* 80, *please*)



Fray Type F Vertical Milling Attachment



Spicer Universal Joints—

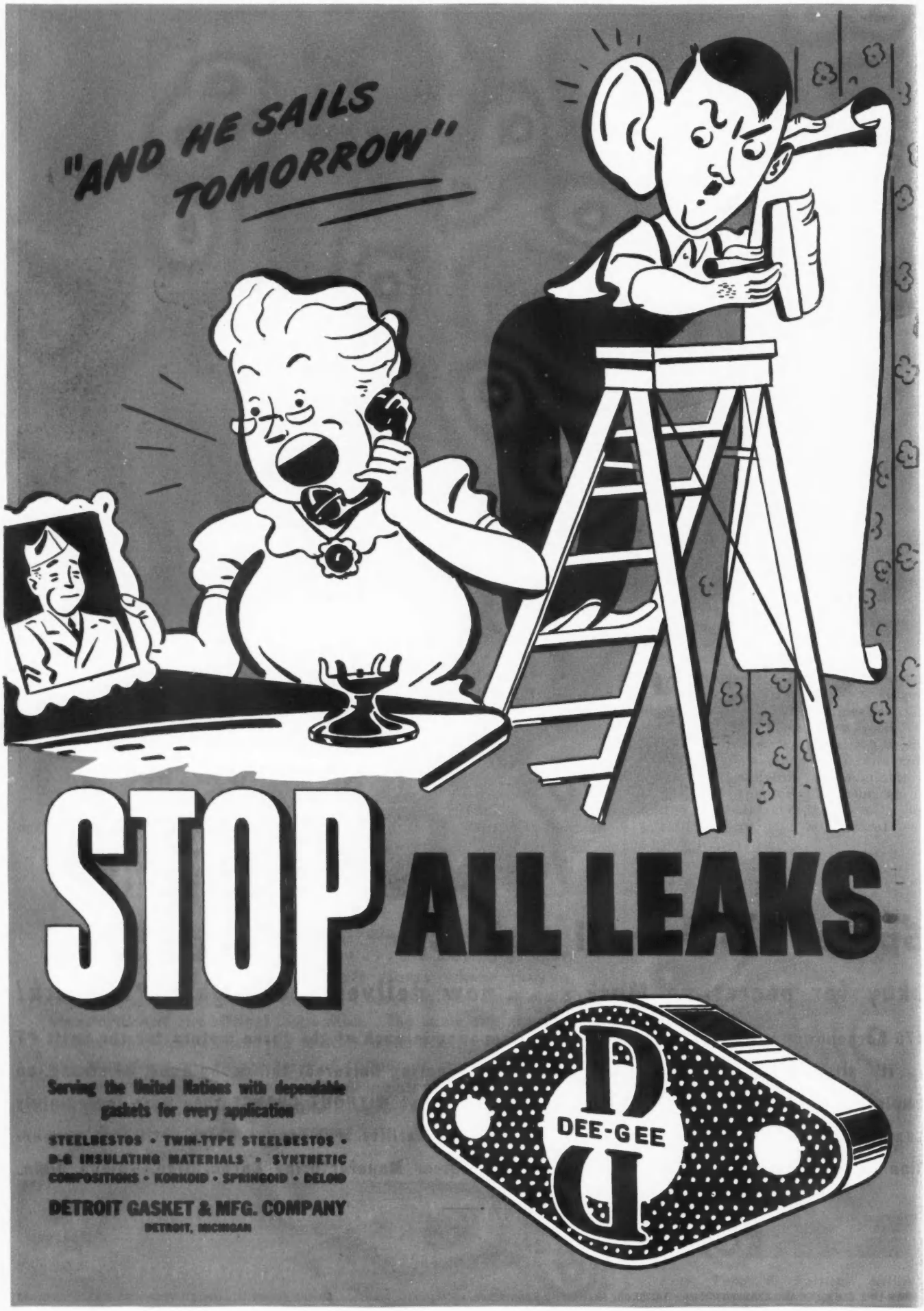
okay for peacetime Mack . . . . now deliver the mighty PT *smack!*

175 horsepower in the Mack . . . or 1350 horsepower in each of the three motors for the swift PT . . . it's all the same to the standard Spicer Needle-Bearing Universal Joints. So good, so strong, so ample in overload capacities are these Spicer units, that WITHOUT CHANGE they were immediately adapted to PT Boat production. And this Spicer versatility will assure quick, efficient conversion to peacetime needs when the war is won. Spicer Manufacturing Corporation, Toledo, Ohio.

40 YEARS OF Spicer SERVICE

BROWN-LIPE CLUTCHES AND TRANSMISSIONS • SALISBURY FRONT AND REAR AXLES

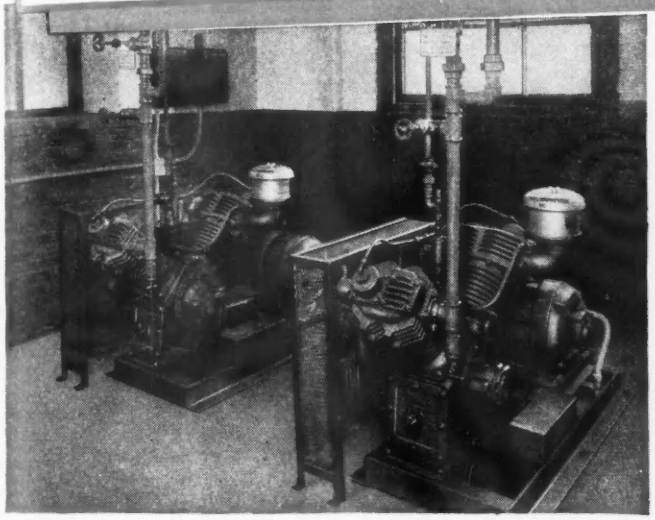
SPICER UNIVERSAL JOINTS • PARISH FRAMES, STAMPINGS

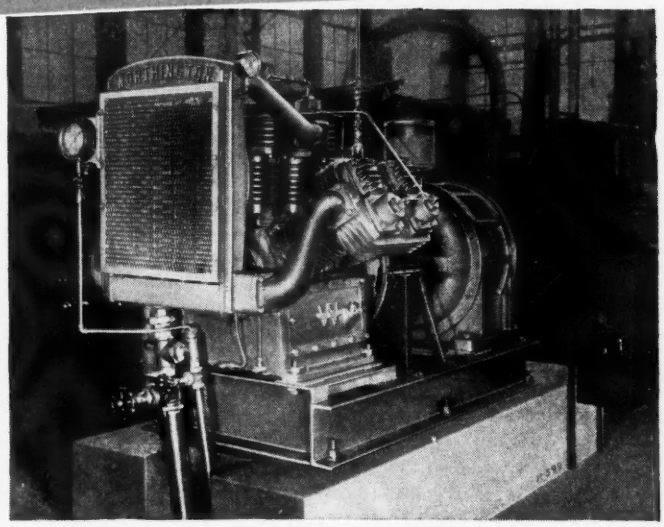

"AND HE SAILS TOMORROW"
STOP ALL LEAKS
Serving the United Nations with dependable gaskets for every application
STEELBESTOS • TWIN-TYPE STEELBESTOS • D-G INSULATING MATERIALS • SYNTHETIC COMPOSITIONS • KORKOID • SPRINGOID • DELOID
DETROIT GASKET & MFG. COMPANY
DETROIT, MICHIGAN
DEE-GEE

COMPRESSED AIR . . . WHERE YOU WANT IT . . . WHEN YOU WANT IT . . .

WORTHINGTON RADIAL TYPE AIR-COOLED UNITS

READILY PLACED CLOSE TO POINTS WHERE AIR IS NEEDED





Do your expanded activities call for additional compressed air . . . or for air at locations not served by your present equipment? In either case, consider these points in favor of Worthington radial type units:

AIR-COOLED . . . No water piping to install or maintain.

PORTABILITY . . . No foundation required. Can be set up quickly at any convenient place, and moved easily to meet changing needs.

COMPACTNESS . . . Minimum floor space requirements.

RELIABILITY . . . Incorporate the same basic design features as in the larger Worthington compressors . . . assuring years of uninterrupted operation at high efficiency.

District Office Engineers and our Authorized Dealer, in your territory, are ready to assist in selecting the correct type and size of compressor for your particular requirements.

WRITE FOR BULLETIN H-620-B16F.

AC3-5

WORTHINGTON FEATURES

- **FEATHER VALVES.** Considered by leading engineers as the simplest, lightest and most efficient valves ever developed for compressor service.
- **AIRPLANE TYPE CONNECTING RODS.** With balanced radial design, all rods connect to single crankpin bearing, held rigid by four bolts.
- **FORCE-FEED LUBRICATION TO CRANKPIN AND WRISTPIN BEARINGS.** Only filter-cleaned oil reaches bearing surfaces. Saves 50% to 75% of lubrication cost, and extends compressor life by reducing bearing and cylinder wear.
- **FORCED-DRAFT AIR COOLING.** Effectively cools the cylinder heads where greatest heat is generated, thus increasing efficiency. All cylinders are isolated for maximum heat radiation.

TYPICAL USES

Light sand blasting—cleaning boiler tubes—paint spraying—metal spraying—operating air tools and rock drills—semi-portable underground service—operating presses — train charging—displacing acids and chemicals—stone cutting — general industrial service

WORTHINGTON

RADIAL AIR COMPRESSORS . . . . FOR AIR ANYWHERE

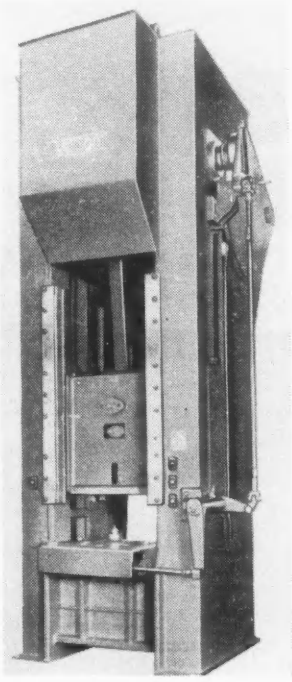
CAPACITIES: 83 TO 445 CU. FT. PER MIN. PRESSURES: 80 TO 125 LB. PER SQ. IN.

WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

(*Continued from page* 76)

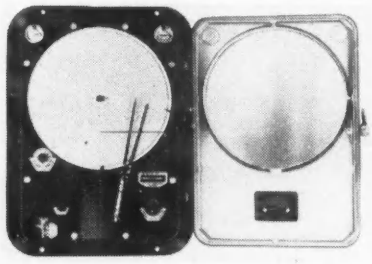
1170 and 3500 with the 1750 rpm motor, or 870, 1300, 2340 and 7000 with the 3500 rpm motor. Overarm adapters are available in various sizes to fit standard overarms, and are calibrated in 360 deg. The housing adjustment is calibrated 30 deg each side of the vertical.

THE Verson Allsteel Press Company, Chicago, Ill., has designed and is building an eccentric type cartridge case drawing press which produces both brass and steel cases. Presses are built for all stages of case fabrication, from preforming through drawing, heading, tapering, to piercing, and are available to make cases of all sizes up to 105 mm. Equipped with a dial feed, it can make as many as 15 productive strokes per minute. The dial is tied into the press circuit, and press cannot operate until the dial is perfectly indexed. The pneumatic clutch and brake unit is controlled electrically by push buttons. Increased punch and die life is obtained by using extra long gibs, which securely confine the slide at all positions of the stroke. Front gibs are adjustable. All gibs are bronze lined. The Verson Eccentric Type Cartridge Case Drawing Press is of solid steel frame welded construction.



Verson Eccentric Type Cartridge Case Drawing Press

AN air-operated automatic control instrument, known as the Convertible Free-Vane Controller, has just been added to the line of instruments made by The Bristol Company, Waterbury, Conn. It is made for automatically controlling temperature flow, liquid level, draft humidity, and time program. The Convertible Free-Vane



The Bristol Convertible Free-Vane Controller

Controller operates on the same basic Free-Vane principle as that used in previous models offered by the company. It incorporates a number of refinements, and is designed so that the user can convert from one type of control system to another. The new controller is offered in the following types: Moncset, Ampliset, Preset, Reset, and Magniset.

A FOUR-STATION grinding bench, with integral dust collector, has been brought out by Schmieg Industries, Detroit, Mich. It is designed for use with portable grinders, on non-hazardous materials.

The unit is said to effect full protection against dust hazards incident

One of the strangest Murders of all time

This is not a pleasant story. We are about to name the murderer in a case that has long been listed as suicide . . . and that murderer is still alive, known to many who read this story.

It happened many years ago. A man named John Fitch was supposed to have taken his own life. The truth is, he was killed — in one of the most reasonless, strange and brutal of all crimes.

He was a shabby man, who tramped through life with the frenzy of a fanatic, clutching a vision under his arm — the plans, designs and models of an invention that would revolutionize this world and bring a new era of wealth and progress to the people of his country . . . They told him that it couldn't be done.

For 15 years he shouted in a wilderness of deaf indifference, hammered at the closed doors of political thought, was branded as crazy, humiliated in public, bereft of funds, and finally killed. They say that he took an overdose of narcotic pills, but John Fitch was murdered.

He was murdered by indifference! Ignorance, stupidity and political blindness killed John Fitch — but not the vision he had offered to the world. It was the plans of a steamboat, designed, built and successfully operated 20 years before the world ever heard of the man named Robert Fulton.

We have a purpose in telling this story. It's simply this: Men are still murdered by indifference. Vision is still the victim of "It can't be done", *perhaps now more than ever before!* And because this is true, we believe that a single fact about Jones & Lamson may be important to you.

Today, the foremost engineers and designers in America are entrusting their plans and problems to Jones & Lamson for counsel, service and technical assistance in the use of precision machine tools.

If it CAN be done . . . and if tools are needed to do it . . . Jones & Lamson engineers and service men are considered among the best qualified in America to help you. Call upon them!

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Die Heads

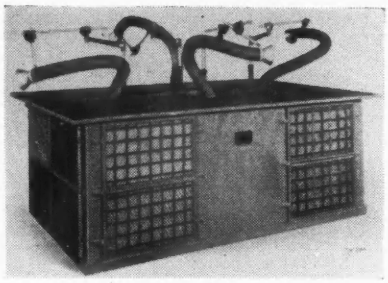
JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.

Profit-producing Machine Tools

to grinding operations. High velocity suction is concentrated at the dust source by means of flexible suction hoses, attached to swivel connections. A special double width, double inlet fan is said to assure complete collection of dust. The finer particles are removed by filters; while a special plenum chamber is provided for the removal of heavy particles.

The bench is of wood frame construction, permitting the attachment of grinding heads and fixtures, and is equipped with a heavy wood top, Masonite covered. Variations in design are available to suit production requirements; each unit being engineered for the particular job it is designed to do.

The unit is furnished complete with fan, four suction hoses, and motor with combination starter and push button.

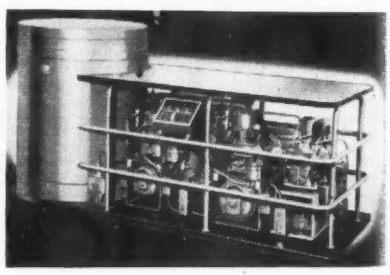


Four Station Grinding Bench made by Schmieg Industries

THE Curran Corporation, Malden, Mass., offers a Dunking and Dryer Basket made entirely from scrap metal. The Dunking Basket Kit is included with a standard five-gallon steel shipping pail, with a removable top, containing the company's Carbon Met substitute for carbon tetrachloride. In operation, parts to be cleaned are placed in the basket and lowered into the volatile Carbon Met. On withdrawing the Dunking Basket, the spring-like clips grip the edge of the container, allowing excess solvent to drain back into the pail.

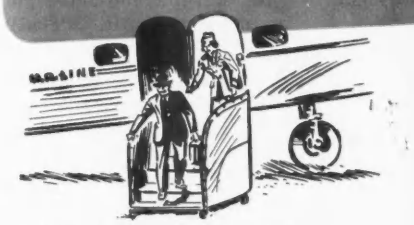
Curran Corporation's Dunking and Dryer Basket Kit

AN improved Deepfreeze Cascade Industrial Chilling Machine has been placed on the market by Motor Products Corporation, North Chicago, Ill. Employing the cascade principle of two-stage refrigeration, this machine can reach temperatures as low as —120 deg F and has the capacity at these low temperatures to remove 1000 Btu per hour when work is immersed in convection fluid. (*See page* 84.)



Deepfreeze Industrial Chilling Machine

SWENSON went a thousand miles . . . to work for half an hour



A Short Story complete on this page

AXEL SWENSON* is a gnarled, sawed-off little Swede. He's been with Pratt & Whitney since he was a boy, and that was in the '80s.

P&W sent a jig borer out to the Red River engine plant awhile back; something had happened to it in transit, and the Martin men couldn't put it together right. They called P&W. It was a job for Axel Swenson.

A P&W jig borer, you know, is one of the things that make mass production possible. It's the world's most accurate machine tool. Its base holds the work in position; its upright column holds the tool. Theoretically, that column ought to be at right angles to the base . . . no more, no less. But of course, that's just theory.

Well, this jig borer at Martin was out of line by some three ten-thousandths of an inch per foot . . . much too big an error to suit either Pratt & Whitney or Martin. Axel was pushed into a plane and away he went, his tool bag under his arm.

Little Axel Swenson walked up to Martin's plush-lined offices and stated his business. They led him out to the machine and he went to work.

For fifteen minutes he just measured the job with instruments from his kit. Then "Hoist 'er oop," he told the man on the crane. The rope slings stretched; the column went up off the base. Axel reached over and scraped the base joint tenderly, slowly, in the place his "know how" told him to touch.

Five minutes later he stepped back. "Hokay," he told the crane man.

Martin men did the measuring this time. They turned to Axel with a gasp. "Only one ten-thousandth of an inch out!" Excited comment rose from the group like a cheer.

Axel was tucking his glasses back in his pocket and putting his tools away when a Martin man, a mischievous twinkle in his eye, stepped up. "Hey, Axel, aren't you going to take out that other tenth?"

Axel looked up slowly. That was asking a lot. That was like asking a man who had just walked across Niagara by tightrope to try it again on one foot. Axel didn't speak. He put his glasses on and got out his measuring tools.

Now the word spread through the Martin shop like wildfire. Axel Swenson is going to try to take out a tenth! In hushed silence, men gathered to watch the old Swede who was locking horns with the infinite.

He had his measurements now. "Oop," he told the crane man. Then he reached in and scraped the selected spot . caressingly, gently as a mother her babe. He stepped back. "Hokay," he said. He picked up his tools and headed for the door.

He picked up his tools and headed for the door.

"Hey! Wait a minute!" the Martin man called after him. "You can't leave here yet!" They hadn't even had a chance to check it. Maybe the old Swede had put it back to three tenths out, or even worse

Axel yielded . . . paused at the door

A Martin man straightened up, faced the group, his eyes bulging. "On the nose!" he breathed. "On the nose! Not a flicker out!" They looked around for Axel . but Axel was on his way to the airport. It didn't surprise *him*.

* * *

Craftsmen like Axel Swenson and tools like the P&W Jig Borer are responsible in important measure for the success of American war production. Their precision underlies every large-scale metalworking operation. If you need *basic accuracy for mass production* — now in war work, later in peace — call on Pratt & Whitney, *Division* Niles-Bement-Pond Co., West Hartford, Conn.

**All names except our own are fictitious; the story, however, is fact.*

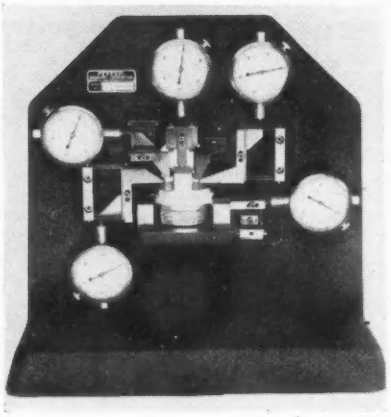
PRATT & WHITNEY

MACHINE TOOLS ★ SMALL TOOLS ★ GAGES

WEST HARTFORD CONNECTICUT

Basic Accuracy for Mass Production

Two stages of refrigeration are used: the first compressor acts to extract heat from the barrel and introduce it to the heat interchanger, the second compressor extracts heat from the heat interchanger and dissipates it into the air. A third compressor cools the heads of the working compressors. Each compressor is driven by a separate motor. A feature recently added is a device for accurate temperature control at any point from atmosphere to —120 deg F.

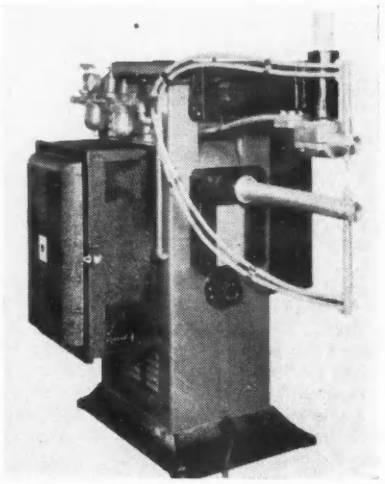


Federal Thickness, Height and Distance Gage

THE Model 247 B-76 thickness, height and distance gage is designed to check, in one operation, five separate dimensions of a fuse body. It is one form of several multiple inspection gages being made by the Federal Products Corporation, Providence, R. I., for checking, simultaneously, several dimensions on parts of various sizes and shapes.

In operation, the gage is first set to a master. Parts are checked by placing them in position and reading the dials, all of which face the operator. The movement of each sensitive contact is transmitted to each dial indicator point through a pantograph unit, a feature which prevents wear or other damage to the dial indicator points through coming in constant contact with the pieces being gaged.

A NEW line of projection or spot welding equipment, in capacities of 10 kva. to 150 kva., has been developed by Universal Power Corporation, Cleveland, Ohio. The unit illustrated features a built-in tube type timer control and timing contactor, integrally mounted, so that all interior wiring is complete. Timer controls regularly supplied govern pre-squeeze, weld, forge and off-timing, variable for each type of welding job.



Universal Spot Welder

Another du Pont Plant

Another plant for the manufacture of "Lucite" methyl methacrylate resin for noses, gun turrets and other transparent sections of military airplanes has started production at Leominster, Mass., according to an announcement by the Plastics Department of E. I. du Pont de Nemours & Company. The entire production is for the government, which will allot it to the aircraft and other war industries. Buildings formerly used in fabricating plastic toilet-ware and other products were renovated and converted to form the new unit, which was completed ahead of schedule.

Douglas Subcontracting System

(*Continued from page* 33)

racy in fixtures and in assemblies, and the need for conserving and salvaging vital tools and materials.

4. Automotive and other subcontractors were shown how to endow their tooling with the flexibility required for the regular improvement and modification demanded by service conditions.

5. Inspection methods to meet Army and Navy aircraft standards were taught to subcontractors' inspection staffs.

6. Subcontractors were guided in certain manufacturing techniques perfected by the aircraft industry, such as dimpling of sheet metal, the forming of aluminum alloys, flush riveting, and the welding of high-grade alloy steel.

7. To assist subcontractors in training their personnel in all these things, Douglas educational experts drafted special courses, provided necessary slides, study materials, and literature. In order that the men and women in subcontractors' plants could be shown on the production line exactly what they were to do and how to do it, the Douglas technique of three-view "production illustrations" was made available.

8. Groups of Douglas employes were loaned to subcontractors, and went to work in their plants during initial stages.

9. Technical data, designs and drawings, processes and manufacturing information were furnished freely and without reservation.

Pooling of Production Facilities

Pooling of facilities within the aircraft industry was pioneered by Douglas and Boeing, each undertaking to build a warplane that had been designed and perfected by the other company. Early in 1940, even before the national emergency arose, Douglas licensed Boeing to produce for the British Government a large number of Douglas DB-7 type attack-bombers. To help Boeing convert its available facilities to production of the DB-7, Douglas furnished the following assistance:

1. Complete engineering data and drawings.

2. Facsimiles of all master planning cards.

3. Drawings for all major jigs and fixtures.

4. Loan of Douglas master jigs.

5. Production and tooling templates duplicated by Douglas and furnished to Boeing.

6. Machines and equipment for spar-cap milling built by Douglas and installed by its personnel in the Boeing plant.

(*Turn to next page*)

7. Patterns, dies and other facilities at vendors plants were made available to Boeing by Douglas.

8. Material release by Douglas made available to Boeing so that it could place orders simultaneously with the same vendors.

9. Douglas materials in excess of $300,000 sold by the company directly to Boeing.

10. All hydro-press parts fabricated for Boeing on Douglas hydro-presses, using Boeing materials.

11. All machine parts subcontracted to Douglas vendors, with Douglas assuming follow-up and inspection responsibilities.

12. In order that certain items of expensive tooling could serve both companies, Douglas fabricated for Boeing from the latter's materials approximately 100 different production parts.

13. Information and ideas, materials, production capacity, as well as engineering, materiel, accounting, planning, production control, and shipping facilities were freely exchanged between the two companies through liaison offices.

Current Pooling

Profiting from their pioneering work, Boeing, Douglas and Vega have pooled their facilities for the concurrent manufacture of B-17F Flying Fortresses designed by Boeing. Coordination was through the BDV Committee, with Boeing furnishing assistance (such as outlined in the first paragraph under the subhead, Pooling of Production Facilities) to the other companies, and with all three exchanging the use of their facilities. Full production of Flying Fortresses under this plan has been under way for many months.

Douglas was licensed by Consolidated to assemble its four-engine, B-24 Liberator bomber at a new Douglas plant in the Midwest. This operation is now under way. Through the coordinating medium of the Aircraft War Production Council, Inc., Douglas and the other member companies have speeded war production by exchanging engineering and production facilities, loaning each other available materials in the event of individual shortages, releasing information on assembly techniques and technical developments, and making available for all, the innovations and improvements developed by each.

To augment the mobilization of resources already afforded through major and lesser subcontractors and production pooling within the industry, Douglas has greatly extended the scope of its purchases of materials, tools, and equipment, enabling some 8000 suppliers in 48 states to help furnish the things that make airplanes.

Big Planes Coming

Consolidated Vultee Aircraft Corp. has a 400-passenger plane in the mock-up stage, President Harry Woodhead revealed recently, but he warned that a four or five-year testing and design period would elapse before the plane is ready for production. He said the War Dept. restricted the revelation of further facts about the projected plane. Meanwhile on the East Coast, Henry Kaiser has received an experimental order from the Navy for a cargo-carrying flying wing with 282-ft wingspread, to be produced at the Hatboro, Pa., plant of Brewster Aeronautical Corp. The proposed plane will be powered by four 2000-hp engines, have a range of 4000 miles and a loaded weight of 87 tons.